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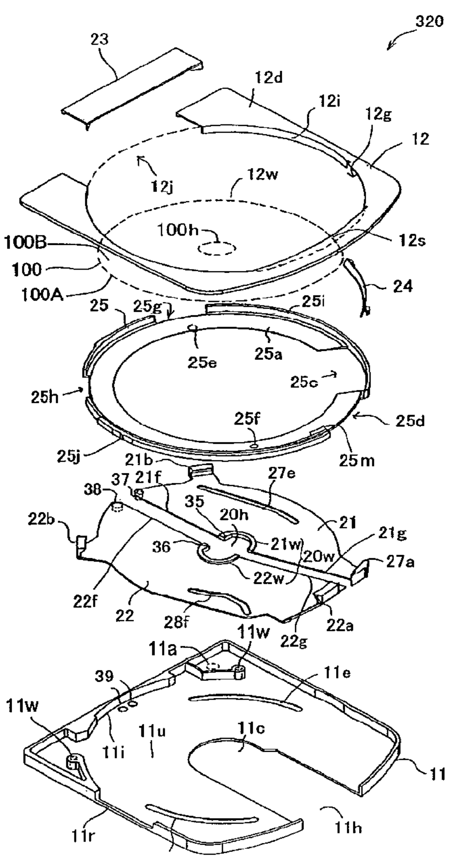
(54) Title: DISC CARTRIDGE



(57) Abstract: A disc cartridge includes a cartridge body, a first shutter, a second shutter, and a rotational member. The cartridgebody includes a disc storage portion, a chucking opening and a head opening. The disc storage portion has a discwindow and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The first and second shutters are provided on the bottom of the disc storage portion to expose or cover the head opening. The rotational member is provided over the first and second shutters inside the disc storage portion and is engaged with the first and second shutters in such a manner as to open or close the first and second shutters when rotates inside the disc storage portion.

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DESCRIPTION

DISC CARTRIDGE

TECHNICAL FIELD

The present invention relates to a disc cartridge for use to store a disk storage medium such as an optical disc or a magnetic disk therein in a rotatable state.

BACKGROUND ART

Various disc cartridges have been proposed as protective cases for disk storage media.

For example, Japanese Laid-Open Publication No. 9-153264 discloses a disc cartridge in which a disk storage medium having a single or double signal recording sides (which will be herein referred to as a "disc" simply) is completely enclosed in a disc storage portion. The disc storage portion is defined inside a cartridge body that is made up of upper and lower halves. The cartridge body includes chucking openings and a head opening. The chucking openings allow the turntable of a spindle motor and a clamper to chuck a disc

inserted, while the head opening allows a read/write head to read and/or write a signal from/on the disc. The lower one of the chucking openings is continuous with the head opening. Accordingly, while the user carries such a cartridge, dust easily enters the inside of the cartridge through these openings and the disc is also easily soiled with finger marks. For that reason, the disc cartridge further includes a shutter for closing these openings up.

A disc cartridge having such a structure, however, has the following drawbacks. Firstly, such a disc cartridge cannot be so thin. This is because the disc storage space, defined between the upper and lower halves, should be thick enough to allow a disc drive to accurately read or write a signal (or information) from/onto the disc stored in such a disc cartridge. The reasons why the disc storage space should be relatively thick include the expected flutter or warp of the disc being rotated and an error that may occur in disposing the disc cartridge at a predetermined position inside the disc drive.

Secondly, the shutter for closing up these chucking and

head openings at the same time cannot be formed at a low cost, thus increasing the overall manufacturing cost of such a disc cartridge. The reason is as follows. Specifically, the lower half of the disc cartridge is provided with a chucking opening for the turntable of the spindle motor and a head opening, while the upper half thereof is provided with another chucking opening for the clamper. Thus, to close these three openings up at a time, the shutter needs to be formed in a U-shape, which is not so cheap to make.

Thirdly, the disc stored inside such a disc cartridge is not fixed in many cases, thus possibly causing dust or fine particle deposition and scratching problems. Specifically, although a disc with a metal hub can be attracted and fixed in position via a magnetic force so as not to move inconstantly, an optical disc with no hub, e.g., a CD or a DVD, is normally not fixed, and movable freely, inside the disc cartridge. Accordingly, when the shutter of the disc cartridge is opened inside the disc drive, dust may enter the cartridge through its openings and be deposited on the disc easily. Also, if the disc is shaken so much as to contact

with the inner walls of the disc cartridge, the signal recording side of the disc may get scratched or fine particles may be stirred up and deposited on the disc.

DISCLOSURE OF INVENTION

In order to overcome the problems described above, an object of the present invention is to provide a disc cartridge that has a reduced thickness and a simplified, much less expensive shutter for a single-sided disc, in particular.

Another object of the present invention is to provide a disc cartridge that can drastically reduce the dust to be deposited on the disc stored therein by getting the disc firmly held inside the disc cartridge and eliminating the inconstant movement of the disc.

A third object of the present invention is to provide a disc cartridge of a good design by displaying the label side of the disc stored therein.

A disc cartridge according to a preferred embodiment of the present invention includes a cartridge body, first and

second shutters and a rotational member. The cartridge body includes a disc storage portion, a chucking opening and a head opening. The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The first and second shutters are provided on the bottom of the disc storage portion to expose or cover the head opening. The rotational member is provided over the first and second shutters inside the disc storage portion and is engaged with the first and second shutters in such a manner as to open or close the first and second shutters when rotates inside the disc storage portion.

In one preferred embodiment of the present invention,

the center of rotation of the rotational member preferably substantially matches with the center of the disc that is stored in the disc storage portion.

In this particular preferred embodiment, the rotational member preferably includes: a disc supporting portion for supporting an outer edge of the second side of the disc thereon; and a notch provided for the disc supporting portion. The notch is preferably located inside the head opening while the first and second shutters are opened.

Specifically, while the first and second shutters are closed, the disc supporting portion preferably contacts with the outer edge of the second side of the disc.

In yet another preferred embodiment, the first and second shutters preferably each include a notch so as to define a hole in a region corresponding to a center hole of the disc while the first and second shutters are closed.

In this particular preferred embodiment, the first and second shutters preferably include first and second convex portions around the notches of the first and second shutters, respectively.

Specifically, the upper surface of the disc supporting portion of the rotational member and the upper surface of the first and second convex portions of the first and second shutters are preferably located at substantially the same vertical levels.

More particularly, the first and second shutters preferably respectively include first and second protrusions that protrude into the center hole of the disc while the first and second shutters are closed.

In that case, the upper surface of the first and second protrusions of the first and second shutters is preferably located at a vertical level higher than the upper surface of the first and second convex portions thereof.

In yet another preferred embodiment, the first and second shutters preferably have their shafts under the disc supporting portion of the rotational member.

In this particular preferred embodiment, the disc supporting portion of the rotational member preferably includes first and second protrusions that protrude toward the bottom of the disc storage portion, and the first and second

shutters preferably include first and second guide grooves that respectively engage with the first and second protrusions of the rotational member.

In yet another preferred embodiment, the rotational member preferably has a sidewall that covers the outer side surface of the disc, and a first opener/closer is preferably provided for the sidewall.

In this particular preferred embodiment, the head opening preferably reaches a first side surface of the cartridge body. The cartridge body preferably has an opening on a second side surface thereof that is adjacent to the first side surface. The first opener/closer is preferably located inside the opening of the second side surface.

In that case, at least one of the first and second shutters preferably includes a second opener/closer that protrudes from the head opening.

In yet another preferred embodiment, the first and second shutters preferably include a number of disc holders. The disc holders preferably contact with an outer edge and a surrounding portion of the disc and preferably hold the disc

thereon while the first and second shutters are closed.

In that case, each of the disc holders preferably has a downwardly tapered slope.

A disc cartridge according to another preferred embodiment of the present invention includes a cartridge body, first and second shutters and a rotational member. The cartridge body includes a disc storage portion, a chucking opening and a head opening. The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The first and second shutters are provided on the bottom of the disc storage portion to expose or cover the head opening. The rotational member is provided over the first and second

shutters inside the disc storage portion and rotates as the first and second shutters are opened or closed. The rotational member includes: a disc supporting portion for supporting an outer edge of the second side of the disc thereon while the first and second shutters are closed; and a notch provided for the disc supporting portion. The notch is located inside the head opening while the first and second shutters are opened.

In one preferred embodiment of the present invention, the disc cartridge preferably further includes a shielding member. The shielding member is preferably located inside the notch of the disc supporting portion while the first and second shutters are closed and preferably swings in a radial direction of the disc.

In this particular preferred embodiment, the shielding member preferably contacts with the outer edge of the disc while the first and second shutters are closed.

Specifically, the shielding member preferably has a shaft that is located over the first side of the disc and that is parallel to a tangent line defined with respect to the disc.

More specifically, the shielding member preferably swings as the rotational member rotates.

Even more specifically, the rotational member preferably includes a sidewall that covers the outer side surface of the disc, and the shaft of the shielding member is preferably located between an upper shell of the cartridge body and the rotational member.

In yet another preferred embodiment, the disc storage portion preferably includes a sidewall along an outer periphery of the bottom. One of the first and second shutters preferably includes a disc holder for applying an elastic force to the disc and holding the disc thereon in such a manner that the outer edge of the disc contacts with the sidewall of the disc storage portion inside the notch of the rotational member while the first and second shutters are closed.

A disc cartridge according to another preferred embodiment of the present invention includes a cartridge body and at least one disc stopper. The cartridge body includes a disc storage portion, a chucking opening and a head opening.

The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The at least one disc stopper is provided for the cartridge body so as to protrude into the disc window and thereby prevent the disc from dropping through the disc window. The radius R1 of the disc and the radius R2 of a smallest circular opening, of which the center matches with the center of the disc window and which is in contact with the disc stopper, preferably satisfy $14/15 \leqq R2/R1$.

In one preferred embodiment of the present invention, the radii R1 and R2 preferably satisfy $14/15 \leqq R2/R1 < 1$.

In another preferred embodiment, the disc cartridge

preferably further includes another disc stopper, and the two disc stoppers are preferably arranged symmetrically with respect to the center of the disc window.

A disc cartridge according to another preferred embodiment of the present invention includes a cartridge body and a type recognizing region. The cartridge body includes a disc storage portion, a chucking opening and a head opening. The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The type recognizing region is provided for the cartridge body to recognize the type of the disc stored in the disc cartridge. The presence and absence of a concave portion in/from the type recognizing

region represent two possible types of the disc stored in the disc cartridge.

In one preferred embodiment of the present invention, the cartridge body includes a positioning hole, which is engageable with a positioning pin of a disc drive, and the type recognizing region is provided near the positioning hole.

In another preferred embodiment, one of the two possible types of the disc to be stored in the disc cartridge has a single signal recording layer, while the other type of the disc has double signal recording layers. If the disc stored in the disc cartridge has a single signal recording layer, then the concave portion is absent from the type recognizing region. If the disc stored in the disc cartridge has double signal recording layers, then the concave portion is present in the type recognizing region.

A disc cartridge according to another preferred embodiment of the present invention includes a cartridge body, a first shutter, a second shutter, a groove, an opener/closer, a first concave portion and a second concave portion. The cartridge body includes a disc storage portion,

a chucking opening and a head opening. The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The first and second shutters are provided on the bottom of the disc storage portion to expose or cover the head opening. The groove is provided on, and extends along, a first side surface of the cartridge body. The opener/closer protrudes through the bottom of the groove and moves along the groove, thereby opening or closing the first and second shutters. The first concave portion is provided on the first side surface of the cartridge body. The second concave portion is provided on a second side surface of the cartridge body. The second side surface is opposed to the

first side surface. The first concave portion is continuous with the groove on the first side surface and has a bottom that is deeper than the bottom of the groove. The bottom of the first concave portion and the bottom of the groove are connected together by a sloped surface that defines a predetermined angle with the bottom of the first concave portion.

In one preferred embodiment of the present invention, the first concave portion passes through the back surface of the cartridge body but does not reach the upper surface of the cartridge body.

In this particular preferred embodiment, a side surface of the first concave portion, which crosses the bottom of the first concave portion, is located closer to the upper surface of the cartridge body than a side surface of the groove, which crosses the bottom of the groove.

In a specific preferred embodiment, the predetermined angle that is defined by the sloped surface with the bottom of the first concave portion is in the range of about 20 degrees to about 40 degrees.

A disc cartridge according to another preferred embodiment of the present invention includes a cartridge body, a first shutter, a second shutter, and a write-protect mechanism. The cartridge body includes a disc storage portion, a chucking opening and a head opening. The disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window. The chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally. The head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc. The first and second shutters are provided on the bottom of the disc storage portion to expose or cover the head opening. The write-protect mechanism is provided for the cartridge body and includes an elongated hole and a sliding member. The elongated hole is provided on the back surface of the cartridge body and includes a first region and

a second region. The sliding member has a raised portion protruding through the elongated hole, and is supported such that the raised portion goes back and forth inside the elongated hole. When the disc cartridge is overlapped with another disc cartridge, which complies with a different set of specifications and which also includes a first region and a second region, such that the center of the disc stored in the former disc cartridge matches with that of the disc stored in the latter disc cartridge and that insert directions of the two disc cartridges are matched with each other, the first region of the another disc cartridge for use to determine whether the disc stored therein is writable or unwritable overlaps with the first region of the disc cartridge almost completely and the second region of the another disc cartridge for use to read information unique to the disc stored therein also overlaps with the second region of the disc cartridge almost completely. The first and second regions of the another disc cartridge are arranged in a direction that is perpendicular to the direction that the front sides of the two disc cartridges face. A direction in which the elongated hole

extends intersects with the direction in which the first and second regions of the another disc cartridge are arranged. The sliding member goes back and forth inside the elongated hole such that the first region of the elongated hole is selectively opened or closed.

In one preferred embodiment of the present invention, the cartridge body includes a side surface having a portion that is parallel to the elongated hole.

Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view illustrating an overall configuration for a disc cartridge according to a first specific preferred embodiment of the present invention.

FIG. **2** is a perspective view of the disc cartridge shown in FIG. **1** as viewed from below it.

FIG. **3** is an exploded perspective view of the disc cartridge shown in FIG. **1**.

FIG. **4** is a cross-sectional view illustrating a disc holder and a surround portion of the disc cartridge shown in FIG. **1**.

FIG. **5** is a cross-sectional view illustrating another disc holder and a surround portion of the disc cartridge shown in FIG. **1**.

FIG. **6** is a perspective view illustrating a state of the disc cartridge shown in FIG. **1** in which its shutter is opened and positioning pins have been inserted into its positioning holes.

FIG. **7** is a cross-sectional view illustrating a disc holder and a surround portion of the disc cartridge shown in FIG. **6**.

FIG. **8** is a perspective view illustrating another disc holder and a surround portion of the disc cartridge shown in FIG. **6**.

FIG. **9** is a plan view illustrating an overall configuration for a disc cartridge according to a second

specific preferred embodiment of the present invention.

FIG. **10** is a plan view illustrating a state of the disc cartridge shown in FIG. **9** in which the disc has been released from its disc holders.

FIG. **11** is a plan view illustrating an overall configuration for a disc cartridge according to a third specific preferred embodiment of the present invention.

FIG. **12** is a plan view illustrating a state of the disc cartridge shown in FIG. **11** in which the disc has been released from its disc holders.

FIG. **13** is a plan view illustrating an overall configuration for a disc cartridge according to a fourth specific preferred embodiment of the present invention.

FIG. **14** is a plan view illustrating a state of the disc cartridge shown in FIG. **13** in which the disc has been released from its disc holder.

FIG. **15** is a plan view illustrating an overall configuration for a disc cartridge according to a fifth specific preferred embodiment of the present invention in a state where its shutter is closed.

FIG. **16** is a cross-sectional view of a disc holder of the disc cartridge in the state shown in FIG. **15**.

FIG. **17** is a plan view illustrating an overall configuration for the disc cartridge shown in FIG. **15** in a state where its shutter is opened.

FIG. **18** is a cross-sectional view of the disc holder of the disc cartridge in the state shown in FIG. **17**.

FIG. **19** is a plan view illustrating an overall configuration for a disc cartridge according to a sixth specific preferred embodiment of the present invention in a state where its shutter is closed.

FIG. **20** is a plan view illustrating an overall configuration for the disc cartridge shown in FIG. **19** in a state where its shutter is opened.

FIG. **21** is a plan view illustrating an overall configuration for a disc cartridge according to a seventh specific preferred embodiment of the present invention in a state where its shutter is closed.

FIG. **22** is a plan view illustrating an overall configuration for the disc cartridge shown in FIG. **21** in a

state where its shutter is opened.

FIG. **23** is a perspective view illustrating an overall configuration for a disc cartridge according to an eighth specific preferred embodiment of the present invention.

FIG. **24** is an exploded perspective view of the disc cartridge shown in FIG. **23**.

FIG. **25** is a perspective view illustrating the disc cartridge shown in FIG. **23** with its upper shell and the disc removed to show a state where its shutters are closed.

FIG. **26** is a perspective view illustrating the disc cartridge shown in FIG. **23** with its upper shell and the disc removed to show a state where its shutters are opened.

FIG. **27** is a perspective view illustrating the disc cartridge shown in FIG. **23** with the disc removed to show a state where its shutters are closed.

FIG. **28** is a perspective view illustrating the disc cartridge shown in FIG. **23** with the disc removed to show a state where its shutters are opened.

FIG. **29** is a partial cross-sectional view of the disc cartridge shown in FIG. **23**, which is viewed along a plane that

passes the center of the disc.

FIG. **30** is a cross-sectional view illustrating a portion of the shutter of the disc cartridge shown in FIG. **23**.

FIG. **31** is a partial plan view illustrating a shutter opener/closer and its surrounding portion of the disc cartridge shown in FIG. **23**.

FIG. **32** is a perspective view illustrating a disc stopper of the disc cartridge shown in FIG. **23**.

FIG. **33** is a front view illustrating the insertion side of the disc cartridge shown in FIG. **23**.

FIG. **34** is a perspective view illustrating an overall configuration for a disc cartridge according to a ninth specific preferred embodiment of the present invention.

FIG. **35** is an exploded perspective view of the disc cartridge shown in FIG. **34**.

FIG. **36** is a perspective view illustrating the disc cartridge shown in FIG. **34** with the disc removed to show a state where its shutters are closed.

FIG. **37** is a perspective view illustrating the disc cartridge shown in FIG. **34** with the disc removed to show a

state where its shutters are opened.

FIG. **38** is a partial cross-sectional view of the disc cartridge shown in FIG. **34**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are closed.

FIG. **39** is a partial cross-sectional view of the disc cartridge shown in FIG. **34**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are opened.

FIG. **40** is a partial cross-sectional view illustrating a portion of the disc cartridge shown in FIG. **34** around the disc outer periphery, which is viewed along a plane passing the center of the disc to show a state where its shutters are closed.

FIG. **41** is a partial cross-sectional view illustrating a portion of the disc cartridge shown in FIG. **34** around the disc outer periphery, which is viewed along a plane passing the center of the disc to show a state where its shutters are opened.

FIG. **42** is a perspective view illustrating an overall

configuration for a disc cartridge according to a tenth specific preferred embodiment of the present invention.

FIG. **43** is an exploded perspective view of the disc cartridge shown in FIG. **42**.

FIG. **44** is a perspective view illustrating the disc cartridge shown in FIG. **42** with the disc removed to show a state where its shutters are closed.

FIG. **45** is a perspective view illustrating the disc cartridge shown in FIG. **42** with the disc removed to show a state where its shutters are opened.

FIG. **46** is a partial cross-sectional view of the disc cartridge shown in FIG. **42,** which is viewed along a plane that passes the center of the disc to show a state where its shutters are closed.

FIG. **47** is a partial cross-sectional view of the disc cartridge shown in FIG. **42,** which is viewed along a plane that passes the center of the disc to show a state where its shutters are opened.

FIG. **48** is a partial cross-sectional view illustrating a portion of the disc cartridge shown in FIG. **42** around the disc

outer periphery, which is viewed along a plane passing the center of the disc to show a state where its shutters are closed.

FIG. **49** is a partial cross-sectional view illustrating a portion of the disc cartridge shown in FIG. **42** around the disc outer periphery, which is viewed along a plane passing the center of the disc to show a state where its shutters are opened.

FIG. **50** is a perspective view illustrating an overall configuration for a disc cartridge according to an eleventh specific preferred embodiment of the present invention.

FIG. **51** is an exploded perspective view of the disc cartridge shown in FIG. **50**.

FIG. **52** is a perspective view illustrating the disc cartridge shown in FIG. **50** with the disc removed to show a state where its shutters are closed.

FIG. **53** is a perspective view illustrating the disc cartridge shown in FIG. **50** with the disc removed to show a state where its shutters are opened.

FIG. **54** is a partial cross-sectional view of the disc

cartridge shown in FIG. **50**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are closed.

FIG. **55** is a partial cross-sectional view of the disc cartridge shown in FIG. **50**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are opened.

FIG. **56** is a cross-sectional view illustrating a portion of the shutter of the disc cartridge shown in FIG. **50**.

FIG. **57** is a partial plan view illustrating a shutter opener/closer and its surrounding portion of the disc cartridge shown in FIG. **50**.

FIG. **58** is a perspective view illustrating a disc cartridge according to a twelfth specific preferred embodiment of the present invention with the disc removed to show a state where its shutters are closed.

FIG. **59** is a partial cross-sectional view of the disc cartridge shown in FIG. **58**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are closed.

FIG. **60** is a perspective view illustrating the disc cartridge shown in FIG. **58** with the disc removed to show a state where its shutters are opened.

FIG. **61** is a partial cross-sectional view of the disc cartridge shown in FIG. **58**, which is viewed along a plane that passes the center of the disc to show a state where its shutters are opened.

FIG. **62** is a perspective view illustrating a modified example of the disc cartridge shown in FIG. **58** with the disc removed to show a state where its shutters are closed.

FIG. **63** is a perspective view illustrating a modified example of the disc cartridge shown in FIG. **58** with the disc removed to show a state where its shutters are opened.

FIG. **64** is a perspective view illustrating an overall configuration for a disc cartridge according to a thirteenth specific preferred embodiment of the present invention.

FIG. **65** is an exploded perspective view of the disc cartridge shown in FIG. **64**.

FIG. **66** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **64** in which its shutters are

closed.

FIG. **67** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **64** in which its shutters are opened.

FIG. **68** is a plan view illustrating the details of the shutter locking mechanism of the disc cartridge shown in FIG. **64**.

FIG. **69** is a cross-sectional view illustrating the details of the disc holder of the shutter in the disc cartridge shown in FIG. **64**.

FIG. **70** is a cross-sectional view illustrating the shapes of a pair of contact portions between the two shutters of the disc cartridge shown in FIG. **64**.

FIG. **71** is a cross-sectional view illustrating the shapes of another pair of contact portions between the two shutters of the disc cartridge shown in FIG. **64**.

FIG. **72** is a perspective view illustrating an overall configuration for a disc cartridge according to a fourteenth specific preferred embodiment of the present invention.

FIG. **73** is a perspective view illustrating the shutters

of the disc cartridge shown in FIG. **72**.

FIG. **74** is a perspective view illustrating the disc holders and their surrounding members of the disc cartridge shown in FIG. **72** to a larger scale.

FIG. **75** is a perspective view illustrating the disc holder and its surrounding portion of the disc cartridge shown in FIG. **72** to a larger scale.

FIG. **76** is a cross-sectional view illustrating the disc holder and its surrounding members of the disc cartridge shown in FIG. **72** to a larger scale.

FIG. **77** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **72** in which its shutters are closed.

FIG. **78** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **72** in which its shutters are opened.

FIG. **79** is a cross-sectional view of the disc cartridge shown in FIG. **72** taken along the line **B-B** shown in FIG. **78**.

FIG. **80** is a cross-sectional view of the disc cartridge shown in FIG. **72** taken along the line **C-C** shown in FIG. **78**.

FIG. **81** is a cross-sectional view of the disc cartridge shown in FIG. **72** taken along the line **A-A** shown in FIG. **77**.

FIG. **82** is a cross-sectional view illustrating a modified example of the disc supporting portion.

FIG. **83** is an exploded perspective view of a disc cartridge according to a fifteenth specific preferred embodiment of the present invention.

FIG. **84** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **83** in which its shutters are closed.

FIG. **85** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **83** in which its shutters are opened.

FIG. **86** is a cross-sectional view of the disc cartridge shown in FIG. **83** taken along the line **D-D** shown in FIG. **84**.

FIG. **87** is a cross-sectional view of the disc cartridge shown in FIG. **83** taken along the line **E-E** shown in FIG. **85**.

FIG. **88** is a perspective view illustrating an overall configuration for a disc cartridge according to a sixteenth specific preferred embodiment of the present invention.

FIG. **89** is an exploded perspective view of the disc cartridge shown in FIG. **88**.

FIG. **90** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **88** in which its shutters are closed.

FIG. **91** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **88** in which its shutters are opened.

FIG. **92** is a schematic plan view illustrating a modified example of the disc cartridge shown in FIG. **88** in which its shutters are closed.

FIG. **93** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **92** in which its shutters are opened.

FIG. **94** is a perspective view illustrating an overall configuration for a disc cartridge according to a seventeenth specific preferred embodiment of the present invention.

FIG. **95** is an exploded perspective view of the disc cartridge shown in FIG. **94**.

FIG. **96** is a schematic plan view illustrating a state of

the disc cartridge shown in FIG. **94** in which its shutters are closed.

FIG. **97** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **94** in which its shutters are opened.

FIG. **98** is a perspective view illustrating an overall configuration for a disc cartridge according to an eighteenth specific preferred embodiment of the present invention.

FIG. **99** is an exploded perspective view of the disc cartridge shown in FIG. **98**.

FIG. **100** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **98** in which its shutters are closed.

FIG. **101** is a schematic plan view illustrating a state of the disc cartridge shown in FIG. **98** in which its shutters are opened.

FIG. **102** is an exploded perspective view of a disc cartridge according to a nineteenth specific preferred embodiment of the present invention.

FIG. **103** is a cross-sectional view illustrating a disc

holder and its surrounding members of the disc cartridge shown in FIG. **102** to a larger scale.

FIG. **104** is an exploded perspective view of a disc cartridge according to a twentieth specific preferred embodiment of the present invention.

FIG. **105** is a plan view illustrating the disc cartridge shown in FIG. **104** with its upper shell removed.

FIG. **106** is a cross-sectional view of the disc cartridge shown in FIG. **104** taken along the line **F-F** shown in FIG. **105**.

FIG. **107** is a plan view illustrating the shutters and rotational member of the disc cartridge shown in FIG. **104** in a state where the shutters are closed.

FIG. **108** is a cross-sectional view of the disc cartridge shown in FIG. **104** taken along the line **G-G** shown in FIG. **107**.

FIG. **109** is a plan view illustrating the shutters and rotational member of the disc cartridge shown in FIG. **104** in a state where the shutters are opened.

FIG. **110** is a cross-sectional view of the disc cartridge shown in FIG. **104** taken along the line **H-H** shown in FIG. **109**.

FIG. **111** is a perspective view illustrating the

shielding member of the disc cartridge shown in FIG. **104**.

FIG. **112** is a cross-sectional view illustrating how the shielding member shown in FIG. **111** is supported by the upper shell.

FIG. **113** is a cross-sectional view illustrating the end of the shielding member in a state where the shutters are closed.

FIG. **114** is a cross-sectional view illustrating the center of the shielding member in a state where the shutters are closed.

FIG. **115** is a cross-sectional view illustrating the end of the shielding member in a state where the shutters are opened.

FIG. **116** is a cross-sectional view illustrating the center of the shielding member in a state where the shutters are opened.

FIG. **117** is a schematic plan view illustrating a modified example of the disc cartridge shown in FIG. **104**.

FIG. **118** is a schematic plan view illustrating another modified example of the disc cartridge shown in FIG. **104**.

FIG. **119** is a plan view of the disc cartridge shown in FIG. **104**.

FIG. **120** is a plan view illustrating the back surface of a disc cartridge according to a twenty-first specific preferred embodiment of the present invention.

FIG. **121** is a side view of the disc cartridge shown in FIG. **120** as viewed in the direction indicated by the arrow **121**.

FIG. **122** is a side view of the disc cartridge shown in FIG. **120** as viewed in the direction indicated by the arrow **122**.

FIG. **123** is a perspective view illustrating main members of the disc cartridge shown in FIG. **120**.

FIG. **124** is a plan view illustrating the write-protect mechanism and surrounding members of the disc cartridge shown in FIG. **120** on a larger scale.

FIG. **125** is an exploded perspective view of the write-protect mechanism for use in the disc cartridge shown in FIG. **120**.

FIG. **126** is a perspective view illustrating a situation

where the write-protect mechanism indicates a writable state.

FIG. **127** is a perspective view illustrating a situation where the write-protect mechanism indicates an unwritable state.

BEST MODE FOR CARRYING OUT THE INVENTION

EMBODIMENT 1

Hereinafter, a disc cartridge **301** according to a first specific preferred embodiment of the present invention will be described with reference to FIGS. **1, 2** and **3**. FIG. **1** is a perspective view illustrating an overall configuration of the disc cartridge **301**, including a disc **100** stored, as viewed from above the cartridge **301**. FIG. **2** is a perspective view of the disc cartridge **301** as viewed from below the cartridge **301**. FIG. **3** is an exploded perspective view illustrating respective parts of the disc cartridge **301**.

The disc **100** includes first and second sides. The first side of the disc **100**, on which its label, for example, is normally printed, is illustrated in FIG. **1**, while the second side thereof, i.e., the signal recording side **100A**, is

illustrated as the backside in FIG. **3**.

As shown in FIG. **1**, the disc cartridge **301** includes a lower shell **11**, an upper shell **12**, disc holders **13**, **14** and a shutter **21**.

As shown in FIG. **3**, the lower shell **11** includes a chucking opening **11c** and a head opening **11h**. The chucking opening **11c** allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **301** externally. The head opening **11h** allows a head, which reads and/or writes a signal from/on the signal recording side **100A** of the disc **100**, to enter the disc cartridge **301** and access a target location on the disc **100**. The lower shell **11** also includes two positioning holes **11w**, which engage with cartridge positioning pins **210** of a disc drive (not shown), thereby fixing the disc cartridge **301** in its predetermined position inside the disc drive. The lower shell **11** faces the signal recording side **100A** of the disc **100**.

The upper shell **12** includes a circular disc window **12w**, through which the disc **100** can be introduced and removed into/from the disc cartridge **301** and which expands over the

entire projection area of the disc **100** to expose the upper side of the disc **100**. The upper and lower shells **12** and **11** are adhered or welded together at their outer periphery, thereby forming a cartridge body **10**.

A disc storage portion **10d** for storing the disc **100** therein (see FIG. **1**) is defined by an inner lower surface **11u** and an inner side surface **12i** of the cartridge body **10**. The inner lower surface **11u** is opposed to the signal recording side **100A** of the disc **100**, while the inner side surface **12i** has a substantially cylindrical shape and defines the disc window **12w** inside. That is to say, the inner lower surface **11u** is the bottom of the disc storage portion **10d**. The inner lower surface **11u** is covered with a protective layer **11p** for the purpose of preventing the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

The protective layer **11p** may be appropriately selected from the group consisting of anti-scratching nonwoven fabric, dustproof nonwoven fabric, anti-scratching coating and dustproof coating. In this preferred embodiment, a sheet of a dustproof nonwoven fabric is adhered or ultrasonic welded

as the protective layer **11p** to the inner lower surface **11u**.

In the disc storage portion **10d**, a gap, which is wide enough to allow the disc **100** to rotate freely, is provided between the inner side surface **12i** and the outer periphery of the disc **100**. Also, the top of the disc storage portion **10d** is the disc window **12w** so that the disc **100** stored in the disc storage portion **10d** has one of its sides exposed inside the disc window **12w**.

As shown in FIG. **3**, the disc cartridge **301** includes two disc holders **13** of the same shape. Each of the disc holders **13** includes a pair of elastic portions **13d** and a hole **13w** that runs obliquely through the disc holder **13**. When the elastic portions **13d** of the disc holders **13** are sandwiched between the upper and lower shells **12** and **11**, an elastic force is applied to the respective inner ends of the disc holders **13** in the direction indicated by the arrows **13B** in FIG. **3**. As a result, the disc **100** is pressed against the inner lower surface **11u**. Also, these two disc holders **13** are disposed so that the holes **13w** thereof are located substantially over the positioning holes **11w**.

The other disc holder **14** includes a shaft **14s** and two elastic portions **14d**. The disc holder **14** is secured to the cartridge body **10** so as to rotate on the shaft **14s**. When the elastic portions **14d** of the disc holder **14** are sandwiched between the upper and lower shells **12** and **11**, an elastic force is applied to the respective inner ends of the disc holder **14** in the direction indicated by the arrow **14B** in FIG. **1**. As a result, the disc **100** is pressed against the inner lower surface **11u**.

The shutter **21** is externally fitted with the lower shell **11** so as to face the signal recording side **100A** of the disc **100**. As shown in FIGS. **1** and **2**, when the shutter **21** is moved horizontally in the direction indicated by the arrow **21A** or **21B**, the chucking opening **11c** and the head opening **11h** are exposed or covered. A shutter spring **31** is extended between the shutter **21** and the cartridge body **10** to apply an elastic force to the shutter **21** in such a direction as to close the shutter **21**.

As shown in FIG. **2**, a label plane or concave portion **10f**, on which the user can note down the contents of the disc **100**

stored, is provided on the bottom of the cartridge body **10** (i.e., the lower shell **11**). As also shown in FIG. **2**, a pair of concave portions **10c**, provided on the right- and left-hand sides of the cartridge body **10**, may be used as either pull-in notches or positioning recesses when the disc cartridge **301** is pulled in and loaded into a disk drive or when the disc cartridge **301** is stored in a changer. Another concave portion **10g** is provided near one of the concave portions **10c**. This concave portion **10g** has such a shape as to prevent the user from inserting this disc cartridge **301** in a wrong direction. That is to say, this concave portion **10g** is just fitted with a convex portion, provided for the disc drive, only when the disc cartridge **301** is inserted in the correct direction. Suppose the user tries to insert the disc cartridge **301** into the disc drive upside down or the wrong way round. In that case, these concave and convex portions are never fitted with each other, thereby preventing the user from inserting this disc cartridge **301** in the wrong way.

Next, it will be described in further detail with reference to FIGS. **4** and **5** how the disc holders **13** and **14** hold

the disc **100** thereon. FIG. **4** is a cross-sectional view of the disc holder **13** in a state where the disc **100** has been mounted thereon as shown in FIGS. **1** through **3**, while FIG. **5** is a cross-sectional view of the disc holder **14** in the state where the disc **100** has been mounted thereon. FIGS. **3** and **4** are both taken in a disc radial direction.

As shown in FIGS. **4** and **5**, the disc holders **13** and **14** include slopes **13'** and **14'**, which are expanded over a portion of the projection area of the disc **100** (i.e., over the outer periphery of the disc **100**), at the respective inner ends thereof. As described above, an elastic force is applied from the elastic portions **13d** or **14d** to the disc holder **13** or **14** in the direction indicated by the arrow **13B** or **14B**. In that situation, the slope **13'** or **14'** contacts with the outer edge **100c** of the disc **100**, thereby gripping the disc **100** thereon and pressing the disc **100** in a thickness direction **100t** thereof. As a result, the signal recording side **100A** of the disc **100** is brought into tight contact with the sheet **11p**. In this manner, the disc **100** is fixed inside the cartridge body **10**. In this state, the outer periphery of the signal

recording side **100A** of the disc **100** keeps a close contact with the sheet **11p**. Thus, no dust will be deposited on the signal recording side **100A**.

Next, it will be described in detail with reference to FIGS. **6, 7** and **8** how the disc **100** is released from the disc holders **13** and **14**.

FIG. **6** is a perspective view illustrating the lower shell **11** of the disc cartridge **301** with the upper shell **12** and the disc **100** removed therefrom. As shown in FIG. **6**, the shutter **21** has its L-shaped portion **21s** pressed by a shutter opening mechanism (not shown) of the disc drive in the direction indicated by the arrow **21A**. As a result, the chucking opening **11c** and the head opening **11h** are now exposed. Also, the cartridge positioning pins **210** of the disc drive are engaged with the positioning holes **11w** of the cartridge body **10**.

FIG. **7** is a cross-sectional view of the disc holder **13** in the state shown in FIG. **6** and is taken in a disc radial direction. FIG. **8** is a perspective view illustrating the disc holder **14** and the shutter **21** in the state shown in FIG. **6** to a larger scale.

As shown in FIG. **7**, when the cartridge positioning pin **210** of the disc drive is inserted into the positioning hole **11w** of the lower shell **11**, the cartridge positioning pin **210** engages with the obliquely running hole **13w** of the disc holder **13**. As a result, the disc holder **13** is lifted in the direction indicated by the arrow **13A**, and the disc **100** is released from the grip of the slope **13'** and is now freely rotatable. At this point in time, the rim **13e** at the end of the disc holder **13** still hangs over a portion of the projection area of the disc **100** (i.e., the outer periphery thereof). Accordingly, even if the disc **100** is released in the disc cartridge **301** that has been loaded into a vertically mounted disc drive, the disc **100** will not drop down from the disc cartridge **301**.

On the other hand, when the shutter **21** is opened, a guide rib **21x** provided on the shutter **21** enters a concave portion **14w** of the disc holder **14**, thereby raising the bottom of the concave portion **14w** as shown in FIG. **8**. As a result, the disc holder **14** is lifted to the direction indicated by the arrow **14A** and the disc **100** is released from the grip of the

slope **14'** and becomes freely rotatable. At this point in time, the rim **14e** at the end of the disc holder **14** still hangs over a portion of the projection area of the disc **100** (i.e., the outer periphery thereof). Accordingly, even if the disc **100** is released in the disc cartridge **301** that has been loaded into a vertically mounted disc drive, the disc **100** will not drop down from the disc cartridge **301**.

Also, to remove the disc **100** intentionally, the user must release the disc **100** from the three disc holders **13** and **14** at the same time. Accordingly, it is possible to prevent the user from removing the disc **100** accidentally.

In this preferred embodiment, the end **21r** of the shutter **21**, which is opposed to the signal recording side **100A** of the disc **100** when the shutter **21** is closed, may be provided with a brush or a dust cleaner as shown in FIG. **2** so that dust is removed from the signal recording side **100A** of the disc **100** every time the shutter **21** is opened and closed. Optionally, the disc cartridge **301** may also include a locking mechanism for locking the disc holders **13** and **14** onto the cartridge body **10** when the disc **100** is mounted thereon.

EMBODIMENT 2

Hereinafter, a disc cartridge **302** according to a second specific preferred embodiment of the present invention will be described with reference to FIGS. **9** and **10**. Specifically, FIG. **9** is plan view illustrating an overall configuration for the disc cartridge **302** in which the disc **100** is held by disc holders. FIG. **10** is a plan view illustrating an overall configuration for the disc cartridge **302** in which the disc **100** has been released from the disc holders. In FIGS. **9** and **10**, each member having substantially the same function as the counterpart of the first preferred embodiment described above is identified by the same reference numeral and the description thereof will be omitted herein.

The disc cartridge **302** of the second preferred embodiment is different from the disc cartridge **301** of the first preferred embodiment in the function and structure of the disc holders. Specifically, the disc cartridge **302** of the second preferred embodiments includes two pairs of disc holders **15** and **16**, which slide in the direction indicated by the arrow **15A** or **15B**, as shown in FIG. **9**.

Each of the disc holders **15** includes an elastic portion **15d**, which applies an elastic force to the disc holder **15** in the direction indicated by the arrow **15B**. Just like the disc holders **13** and **14** of the first preferred embodiment, a slope **15′** provided at the end of each disc holder **15** presses and fixes the disc **100** against the cartridge body **10**.

Each of the disc holders **16** includes a shaft **16c**. That is to say, the disc holder **16** is provided for the cartridge body **10** so as to rotate on its shaft **16c**. Just like the disc holders **13** and **14** of the first preferred embodiment, a slope **16′** provided at the end of each disc holder **16** presses and fixes the disc **100** against the cartridge body **10**. Each of the disc holders **15** further includes a coupling pin **15p**, which is engaged and interlocked with a groove **16g** of its associated disc holder **16**.

When the two cartridge positioning pins **210** of the disc drive are engaged with the positioning holes **11w** of the cartridge body **10**, respective protrusions **15s** of the disc holders **15** are pushed and lifted by the positioning pins **210** as shown in FIG. **10**. As a result, the disc holders **15** are

moved in the direction indicated by the arrow **15A** and the disc **100** is released from the grip of the slopes **15'**. In the meantime, as the disc holders **15** are moved in the direction **15A**, the disc holders **16** are rotated to the direction indicated by the arrow **16A**. Consequently, the disc **100** is also released from the grip of the slopes **16'**.

EMBODIMENT 3

Hereinafter, a disc cartridge **303** according to a third specific preferred embodiment of the present invention will be described with reference to FIGS. **11** and **12**. Specifically, FIG. **11** is plan view illustrating an overall configuration for the disc cartridge **303** in which the disc **100** is held by disc holders. FIG. **12** is a plan view illustrating an overall configuration for the disc cartridge **303** in which the disc **100** has been released from the disc holders. In FIGS. **11** and **12**, each member having substantially the same function as the counterpart of the first preferred embodiment described above is identified by the same reference numeral and the description thereof will be omitted herein.

The disc cartridge **303** of the third preferred embodiment is different from the disc cartridge **301** of the first preferred embodiment in the function and structure of the disc holders. Specifically, the disc cartridge **303** of the third preferred embodiments includes two pairs of disc holders **17** and **18**, to which an elastic force is applied in the directions indicated by the arrows **17B** and **18B**, respectively, as shown in FIG. **11**. These disc holders **17** and **18** have been molded together with the cartridge body **10** so as to form integral parts of the cartridge body **10**.

Each of the disc holders **17** includes an elastic portion **17d**, which applies an elastic force to the disc holder **17** in the direction indicated by the arrow **17B**. Just like the disc holders **13** and **14** of the first preferred embodiment, a slope **17'** provided at the end of each disc holder **17** presses and fixes the disc **100** against the cartridge body **10**.

Each of the disc holders **18** also includes an elastic portion **18d**, which applies an elastic force to the disc holder **18** in the direction indicated by the arrow **18B**. A slope **18'** provided at the end of each disc holder **18** also

presses and fixes the disc **100** against the cartridge body **10**.

When this disc cartridge **303** is inserted into a disc drive **200**, a pair of disc releasing pins **217**, provided for the disc drive **200**, presses protrusions **17s** of the disc holders **17**. As a result, the disc **100** is released from the disc holders **17** as shown in FIG. **12**. At the same time, another pair of disc releasing pins **218**, also provided for the disc drive **200**, contacts with the side surfaces **18s** of the disc holders **18**. Consequently, the disc **100** is also released from the disc holders **18** as shown in FIG. **12**.

EMBODIMENT 4

Hereinafter, a disc cartridge **304** according to a fourth specific preferred embodiment of the present invention will be described with reference to FIGS. **13** and **14**. Specifically, FIG. **13** is plan view illustrating an overall configuration for the disc cartridge **304** in which the disc **100** is held by a disc holder. FIG. **14** is a plan view illustrating an overall configuration for the disc cartridge **304** in which the disc **100** has been released from the disc holder. In FIGS. **13** and **14**,

each member having substantially the same function as the counterpart of the first preferred embodiment described above is identified by the same reference numeral and the description thereof will be omitted herein.

The disc cartridge **304** of the fourth preferred embodiment is different from the disc cartridge **301** of the first preferred embodiment in the function and structure of the disc holder. Specifically, the disc cartridge **304** includes a ringlike disc holder **19**.

As shown in FIG. **13**, the disc holder **19** is a ringlike elastic member, which is made of rubber, for example, and can change its shape freely. When no force is externally applied thereto, the disc holder **19** has an ellipsoidal planar shape. However, by applying an external force thereto, the disc holder **19** may be deformed into a substantially completely round shape. In that case, the inside diameter of the disc holder **19** is greater than the diameter of the disc **100**.

As shown in FIG. **13**, the ellipsoidal disc holder **19** is in contact with the disc **100** at multiple points, thereby fixing the disc **100** onto the cartridge body **10**. However, when this

disc cartridge **304** is inserted into a disc drive **200**, convex portions **219**, provided for the disc drive **200**, press the major axis portion of the ellipsoidal disc holder **19**, thereby deforming the disc holder **19** as shown in FIG. **14**. As a result, the disc holder **19** is deformed into an approximately completely round shape and is no longer in contact with the disc **100**. That is to say, the disc **100** is released from the disc holder **19**.

To release the disc **100** from the disc holder **19**, the force that deforms the disc holder **19** may also be applied from the convex portion of the disc drive **200**, which engages with the concave portion **10g** (see FIG. **2**) provided for preventing the user from inserting the disc cartridge in the wrong direction, to the disc holder **19**. Alternatively, that force may also be applied from a pair of convex portions of the disc drive **200**, which engages with the concave portions **10c** (see FIG. **2**) provided on the right- and left-hand sides of the disc cartridge **304** for pulling in the disc cartridge **304**, to the disc holder **19**.

EMBODIMENT 5

Hereinafter, a disc cartridge **305** according to a fifth specific preferred embodiment of the present invention will be described with reference to FIGS. **15** through **18**. FIGS. **15** and **17** are plan views illustrating the structure of the disc cartridge **305** of the fifth preferred embodiment from which the upper shell has been removed. Specifically, FIG. **15** illustrates a state where the shutter **21** covers the openings **11h** and **11c**, while FIG. **17** illustrates a state where the shutter **21** exposes the openings **11h** and **11c**. FIGS. **16** and **18** illustrate states of a disc holder **43** when the shutter **21** is closed and when the shutter **21** is opened, respectively.

In FIGS. **15** through **18**, each member having substantially the same function as the counterpart of the first preferred embodiment described above is identified by the same reference numeral.

The disc cartridge **305** of the fifth preferred embodiment is characterized in that the disc holding and releasing operations and the opening and closing operations are synchronously performed by disc holders **43** and the shutter **21**,

respectively, by way of a disc holder/shutter interlocking member **44**.

The disc holder/shutter interlocking member **44** is provided over the inner lower surface **11u** so as to rotate and slide around the chucking opening **11c** of the lower shell **11** as indicated by the arrow **44A** in FIGS. **15** and **17**. The disc holder/shutter interlocking member **44** has a fan shape, or in the shape of a partially notched ring that has an inside diameter equal to the diameter of the chucking opening **11c**.

The disc holder/shutter interlocking member **44** includes a pin **47** that extends toward the lower shell **11** (i.e., in the direction going into the paper of FIGS. **15** and **17**). The lower shell **11** and the shutter **21** are respectively provided with guide grooves **11m** and **21m** that both engage with the pin **47**. Also, multiple protrusions **45**, which extend outward and upward (i.e., in the direction coming out of the paper of FIGS. **15** and **17**), are provided on the outer periphery of the disc holder/shutter interlocking member **44**. Furthermore, the upper surface of the disc holder/shutter interlocking member **44** is covered with a nonwoven fabric or a coating to prevent the

signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

A number of disc holders **43** are disposed at predetermined intervals on the inner lower surface **11u** so as to hold the outer edge of the disc **100** thereon when the disc **100** is stored in the disc cartridge **305**. In the preferred embodiment shown in FIGS. **15** and **17**, three disc holders **43** are provided. Alternatively, two, four or more disc holders **43** may also be provided. In any case, each of those disc holders **43** is secured to the lower shell **11** so as to rotate on the shaft **43A** thereof.

As shown in FIG. **16**, each of the disc holders **43** is located at such a position so as to partially overlap with the outer periphery of the disc holder/shutter interlocking member **44**. Also, an elastic portion (not shown in FIG. **16**) such as the elastic portion **14d** shown in FIG. **5**, for example, applies an elastic force to each disc holder **43** downward (i.e., toward the lower shell **11**). Accordingly, while contacting with the outer edge of the disc **100**, the slope **43'** of the disc holder **43** not only presses the disc **100** in the direction indicated by

the arrow **43B** in FIG. **16** so that the disc **100** is brought into contact with the disc holder/shutter interlocking member **44** but also holds the disc **100** thereon.

As shown in FIG. **15**, when the disc cartridge **305** including the disc (not shown) is inserted into a disc drive **200** in the direction indicated by the arrow **1A**, a shutter opener/closer (not shown), provided for the disc drive **200**, moves the shutter **21** in the direction indicated by the arrow **21A**, thereby opening the shutter **21**. When the shutter **21** starts to move in the direction **21A**, a force is also applied in the direction **21A** to the pin **47** of the disc holder/shutter interlocking member **44** that is engaged with the guide groove **21m** of the shutter **21**. As a result, the pin **47** is moved along the guide groove **11m** of the lower shell **11**, and the disc holder/shutter interlocking member **44** starts to rotate to the direction indicated by the arrow **44A** around the chucking opening **11c**. The guide groove **11m** preferably extends approximately in the direction in which the shutter **21** is moved so that the disc holder/shutter interlocking member **44** moves along with the shutter **21**.

When the shutter **21** is completely open, the protrusions **45** on the outer periphery of the disc holder/shutter interlocking member **44** are located under the disc holders **43** as shown in FIG. **17**. Then, as shown in FIG. **18**, the disc holders **43** are pushed up by the protrusions **45** and the slopes **43'** of the disc holders **43** separate themselves from the outer edge of the disc **100**. As a result, the force that has been vertically applied to the disc **100** in the direction indicated by the arrow **43B** is removed from the disc **100** and the disc **100** is now freely rotatable. At this point in time, the rim **43e** at the end of the disc holder **43** still hangs over a portion of the projection area of the disc **100** (i.e., the outer periphery thereof). Accordingly, even if the disc **100** is released in the disc cartridge **305** that has been loaded into a vertically mounted disc drive, the disc **100** will not drop down from the disc cartridge **305**.

In the disc cartridge **305** of the fifth preferred embodiment, the disc can be released even if the disc cartridge **305** is not inserted into the disc drive **200**. Accordingly, if the shutter **21** is opened manually, the disc

holders **43** will release the disc **100** synchronously with the movement of the shutter **21**. Thus, the user can remove an unwanted disc from the cartridge **305** and insert a new disc thereto any time he or she likes.

EMBODIMENT 6

Hereinafter, a disc cartridge **306** according to a sixth specific preferred embodiment of the present invention will be described with reference to FIGS. **19** and **20**. FIGS. **19** and **20** are plan views illustrating the structure of the disc cartridge **306** of the sixth preferred embodiment from which the upper shell has been removed. Specifically, FIG. **19** illustrates a state where the shutter covers the head opening **11h**, while FIG. **20** illustrates a state where the shutter exposes the opening **11h**. In FIGS. **19** and **20**, each member having substantially the same function as the counterpart of the first or fifth preferred embodiment described above is identified by the same reference numeral.

The disc cartridge **306** of the sixth preferred embodiment is characterized in that the shutter **46** thereof performs the

functions of the disc holder/shutter interlocking member **44** and the shutter **21** of the disc cartridge **305** of the fifth preferred embodiment. The shutter **46** is provided over the inner lower surface **11u** so as to rotate and slide around the chucking opening **11c** of the lower shell **11** as indicated by the arrow **46B** in FIGS. **19** and **20**. The shutter **46** has a fan shape, or in the shape of a partially notched ring that has an inside diameter equal to the diameter of the chucking opening **11c**.

The shutter **46** includes a pin **46p** that extends toward the lower shell **11** (i.e., in the direction going into the paper of FIGS. **19** and **20**). The lower shell **11** is provided with a guide groove **11m** that engages with the pin **46p**. When the pin **46p** is located at one end of the guide groove **11m**, the head opening **11h** is closed up by the shutter **46**. And when the pin **46p** is located at the other end of the guide groove **11m**, the head opening **11h** is exposed by the shutter **46**. The guide groove **11m** is provided along a portion of an arc that is concentric with the chuck opening **11c**. The guide groove **11m** preferably extends approximately in the direction **1A** in which the disc cartridge **306** is inserted into a disc drive **200** so that the

shutter **46** is opened as the disc cartridge **306** is inserted into the disc drive **200**.

Multiple protrusions **46c**, which extend outward and upward (i.e., in the direction coming out of the paper of FIGS. **19** and **20**), are provided on the outer periphery of the shutter **46**. Furthermore, the upper surface of the shutter **46** is covered with a nonwoven fabric or a coating to prevent the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

A number of disc holders **43**, having a structure similar to that of the disc holders of the fifth preferred embodiment, are disposed at predetermined intervals on the inner lower surface **11u**. The disc holders **43** and the protrusions **46c** of the shutter **46** together hold or release the disc synchronously with the movement of the shutter **46** as already described for the fifth preferred embodiment.

When the disc cartridge **306** of the sixth preferred embodiment is inserted into the disc drive **200** in the direction indicated by the arrow **1A** in FIG. **19**, the pin **46p** of the shutter **46** will soon contact with a contact member **201**

provided for the disc drive **200**. And when the disc cartridge **306** is inserted deeper into the disc drive **200**, the pin **46p** is pressed by the contact member **201** to start to move along the guide groove **11m**. Then, the shutter **46** starts to rotate around the chucking opening **11c** of the lower shell **11** to the direction indicated by the arrow **46B** in FIG. **19**. As the shutter **46** rotates to that direction, the head opening **11h** is opened little by little.

As shown in FIG. **20**, when the disc cartridge **306** has been fully inserted into the disc drive **200**, the pin **46p** will reach the other end of the guide groove **11m**. As a result, the head opening **11h** is completely exposed. At this point in time, as already described for the fifth preferred embodiment, the protrusions **46c** on the outer periphery of the shutter **46** are located under the disc holders **43** as shown in FIG. **20**. Then, the disc holders **43** are pushed up by the protrusions **46c** toward the upper shell **12** (i.e., in the direction coming out of the paper of FIG. **20**). As a result, the disc **100** that has been held by the disc holders **43** is released and now freely rotatable.

The disc cartridge **306** of the sixth preferred embodiment needs no disc holder/shutter interlocking member. Thus, compared to the disc cartridge **305** of the fifth preferred embodiment, the disc cartridge **306** can be thinner. Also, if the pin **46p** is moved manually along the guide groove **11m**, the shutter **46** can be opened and the disc can be released and removed from the disc holders **43**.

In the sixth preferred embodiment described above, the shutter **46** is rotated clockwise as viewed from over the upper shell of the cartridge **306**. However, the shutter **406** may also be rotated counterclockwise if the guide groove **11m** is formed at a different position.

EMBODIMENT 7

Hereinafter, a disc cartridge **307** according to a seventh specific preferred embodiment of the present invention will be described with reference to FIGS. **21** and **22**. FIGS. **21** and **22** are plan views illustrating the structure of the disc cartridge **307** of the seventh preferred embodiment from which the upper shell has been removed. Specifically, FIG. **21**

illustrates a state where the shutter covers the head opening **11h**, while FIG. **22** illustrates a state where the shutter exposes the head opening **11h**. In FIGS. **21** and **22**, each member having substantially the same function as the counterpart of the third or sixth preferred embodiment described above is identified by the same reference numeral.

The disc cartridge **307** of the seventh preferred embodiment is different from the disc cartridge **306** of the sixth preferred embodiment in the structure of the disc holders. Specifically, as shown in FIGS. **21** and **22**, the disc cartridge **307** includes a plurality of disc holders **17**. Just like the disc holders of the third preferred embodiment described above, each of these disc holders **17** also includes an elastic portion **17d**. While the shutter **46** is going to be closed, the elastic portions **17d** apply an elastic force to the disc **100** mounted, thereby holding and pressing the disc **100** toward the center thereof as indicated by the arrows **17R** in FIG. **21**. In this preferred embodiment, the disc holders **17** form integral parts of the lower shell **11**. Alternatively, the disc holders **17** may also be formed separately from the lower

shell **11**.

When taken in the disc radial direction, each of these disc holders **17** also has a slope that expands over a portion of the projection area of the disc (i.e., the outer periphery of the disc **100**) just like the disc holder **43** shown in FIG. **18**. Accordingly, if the disc **100** gets held by the disc holders **17** so as to have its outer edge contact with the respective slopes of the disc holders **17**, then the disc **100** is pressed against the shutter **46**.

The shutter **46** includes a plurality of protrusions **46c** on the outer periphery thereof. In this preferred embodiment, the protrusions **46c** protrude outward. Also, the protrusions **46c** are located at such positions on the outer periphery of the shutter **46** as to contact with the elastic portions **17d** of the disc holders **17** when the shutter **46** is opened as shown in FIG. **22**.

As shown in FIG. **22**, when the shutter **46** is opened, the protrusions **46c** dominate the inwardly applied elastic force of the elastic portions **17d**, thereby pushing the elastic portions **17d** outward as indicated by the arrows **17s**. As a result, the

disc **100** is released. However, each of the disc holders **17** also includes a rim **17e** at the end thereof. Even after the disc **100** has been released, the rim **17e** still hangs over a portion of the projection area of the disc **100**. Accordingly, even if the disc **100** is released in the disc cartridge **307** that has been loaded into a vertically mounted disc drive **200**, the disc **100** will not drop down from the disc cartridge **307**.

The disc cartridge **307** of the seventh preferred embodiment achieves all the effects of the sixth preferred embodiment described above. In addition, according to this seventh preferred embodiment, the disc holders **17** may form integral parts of the lower shell **11**. Then, the disc cartridge can have a simplified structure and can be formed at a low manufacturing cost.

EMBODIMENT 8

Hereinafter, a disc cartridge **308** according to an eighth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

First, the structure of the disc cartridge **308** will be

outlined with reference to FIGS. **23** and **24**. As in the first preferred embodiment described above, the disc **100** shown in FIGS. **23** and **24** also includes first and second sides. The first side of the disc, on which its label, for example, is normally printed, is illustrated in FIG. **23**, while the second side thereof, i.e., the signal recording side **100A**, is illustrated as the backside in FIG. **24**.

As shown in FIGS. **23** and **24**, the disc cartridge **308** includes a lower shell **11**, an upper shell **12**, a pair of shutters **21** and **22** and disc stoppers **23**.

As shown in FIG. **24**, the lower shell **11** includes a chucking opening **11c** and a head opening **11h**. The chucking opening **11c** allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **308** externally. The head opening **11h** allows a head, which reads and/or writes a signal from/on the signal recording side **100A** of the disc **100**, to enter the disc cartridge **308** and access a target location on the disc **100**. The lower shell **11** faces the signal recording side **100A** of the disc **100**. Also, the head opening **11h** reaches a side surface of the lower shell **11**.

The upper shell **12** includes a circular disc window **12w**, through which the disc **100** can be introduced and removed into/from the disc cartridge **308** and which expands over the entire projection area of the disc **100** to expose the upper side of the disc **100**. The upper and lower shells **12** and **11** are adhered or welded together at their outer periphery, thereby forming a cartridge body **10**.

A disc storage portion **10d** for storing the disc **100** therein is defined by an inner lower surface **11u** and an inner side surface **12i** of the cartridge body **10**. The inner lower surface **11u** is opposed to the signal recording side **100A** of the disc **100**, while the inner side surface **12i** has a substantially cylindrical shape and defines the disc window **12w** inside. That is to say, the inner lower surface **11u** is the bottom of the disc storage portion **10d**.

In the disc storage portion **10d**, a gap, which is wide enough to allow the disc **100** to rotate freely, is provided between the inner side surface **12i** and the outer periphery of the disc **100**. Also, the top of the disc storage portion **10d** is the disc window **12w** so that the disc **100** stored in the disc

storage portion **10d** has one of its sides exposed inside the disc window **12w**.

Two removable disc stoppers **23** are provided for the upper shell **12** so as to partially protrude into the disc window **12w** as shown in FIGS. **23** and **24**. A third disc stopper **12s** is further provided for the upper shell **12** so as to protrude into the disc window **12w**. But the third disc stopper **12s** forms an integral part of the upper shell **12**. These three disc stoppers **23** and **12s** are arranged substantially at regular intervals around the circumference of the disc window **12w** for the purpose of preventing the disc **100** from dropping down from the disc window **12w**. These disc stoppers **23** and **12s** are effective particularly when this disc cartridge **308** is loaded into a vertically mounted disc drive.

The shutters **21** and **22** are disposed between the signal recording side **100A** of the disc **100** and the inner lower surface **11u** of the cartridge body **10**. The shutters **21** and **22** include holes **21u** and **22u**, respectively. These holes **21u** and **22u** are engaged in a freely rotatable state with shafts **11s**, which are located outside of the disc storage portion **10d** of

the cartridge body **10** and on a deep side of the cartridge body **10** opposite to the head opening **11h** thereof. Thus, the shutters **21** and **22** rotate on the shafts **11s** in such a manner as to cover or expose the chucking and head openings **11c** and **11h**.

A cam **21c** and a follower **22c** are provided near the holes **21u** and **22u** of the shutters **21** and **22**, respectively. The cam **21c** and the follower **22c** have mutually engaging shapes and together make up an interlocking mechanism **20c** for opening and closing the shutters **21** and **22** while interlocking them with each other.

The respective upper surfaces of the shutters **21** and **22**, which are opposed to the signal recording side **100A** of the disc **100**, are covered with protective layers **21p** and **22p** for the purpose of preventing the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

The protective layers **21p** and **22p** may be appropriately selected from the group consisting of anti-scratching nonwoven fabric, dustproof nonwoven fabric, anti-scratching coating and dustproof coating. In this preferred embodiment,

sheets of a dustproof nonwoven fabric are adhered or ultrasonic welded as the protective layers **21p** and **22p** to the shutters **21** and **22**, respectively.

Shutter springs **31** and **32** are provided outside of the disc storage portion **10d** for the shutters **21** and **22**, respectively. These springs **31** and **32** apply an elastic force to the shutters **21** and **22** in such a direction as to close the shutters **21** and **22**. Optionally, an elastic force may also be applied from any other type of elastic members to the shutters **21** and **22** in that direction.

In the disc cartridge **308** shown in FIG. **24**, the shutters **21** and **22** each include two disc holders **21a**, **21b** and **22a**, **22b** at both ends thereof. Each of these disc holders **21a**, **21b**, **22a** and **22b** has a downwardly tapered cross-sectional shape (or slope) to grip the outer edge of the disc **100** while the shutters **21** and **22** are closed. The structure and operation of the disc holders **21a**, **21b**, **22a** and **22b** will be described in further detail later.

As shown in FIG. **23**, the upper surface of the cartridge body **10** (or the upper shell **12**) has a label plane **10f**, on

which the user can note down the contents of the disc **100** stored, and embossed arrow marks (or concave portions) **10a** that indicate the direction (the arrow **1A**) in which this disc cartridge **308** should be inserted into a disc drive. The cartridge body **10** further includes two concave portions **10c** on two of its side surfaces that are parallel to the direction **1A** in which the disc cartridge **308** is inserted. These concave portions **10c** may be used as either pull-in notches or positioning recesses when the disc cartridge **308** is pulled in and loaded into a disk drive or when the disc cartridge **308** is stored in a changer.

FIG. **25** is a perspective view illustrating the disc cartridge **308** with the upper shell **12** and the disc **100** removed to show a state where the shutters **21** and **22** cover the chucking and head openings **11c** and **11h**. In FIG. **25**, the disc holders **21a**, **21b**, **22a** and **22b** of the shutters **21** and **22** are located at such positions as to grip the outer edge of the disc **100** (not shown in FIG. **25**).

FIG. **26** is a perspective view illustrating the disc cartridge **308** with the upper shell **12** and the disc **100** removed

to show a state where the shutters **21** and **22** expose the chucking and head openings **11c** and **11h**. As a result of the rotation of the shutters **21** and **22** on their holes **21u** and **22u**, respectively, the chucking and head openings **11c** and **11h** are now exposed. Also, as the shutters **21** and **22** have rotated, the disc holders **21a, 21b, 22a** and **22b** have also rotated on the holes **21u** and **22u**. Consequently, the disc holders **21a, 21b, 22a** and **22b** are now separated from the outer edge of the disc **100** (not shown in FIG. **26**).

FIG. **27** is a perspective view illustrating the disc cartridge **308**, on which the disc **100** has not been mounted yet, to show a state where the shutters **21** and **22** cover the chucking and head openings **11c** and **11h**. As shown in FIG. **27**, the disc holders **21a, 21b, 22a** and **22b** protrude into the disc storage portion **10d**. Thus, when the disc **100** is stored in this disc cartridge **308**, the disc **100** is held by these disc holders **21a, 21b, 22a** and **22b**. On the other hand, FIG. **28** is a perspective view illustrating the disc cartridge **308**, on which the disc **100** has not been mounted yet, to show a state where the shutters **21** and **22** expose the chucking and head

openings **11c** and **11h**. As shown in FIG. **28**, while the shutters **21** and **22** are opened, the disc holders **21a**, **21b**, **22a** and **22b** are stored outside of the disc storage portion **10d** of the cartridge body **10**.

Next, the structure and the operation of the shutters **21** and **22** will be described in further detail with reference to FIGS. **29**, **30** and **31**. FIG. **29** is a partial cross-sectional view of the disc cartridge **308**, which is viewed along a plane that passes the center of the disc **100**. As shown in FIG. **29**, the inner side surface **12i** of the cartridge body **10** is provided with a notched portion **10w** so as not to interfere with the opening and closing operations of the shutters **21** and **22**. Also, the cartridge body **10** further includes shutter storage **10s** for storing a portion of the shutters **21** and **22** being opened. Furthermore, at least the edges **21f** and **22f** of the shutters **21** and **22**, which are butted against each other over the chucking and head openings **11c** and **11h** while the shutters **21** and **22** are closed, overlap with each other vertically (i.e., in the thickness direction of the disc **100**) as shown in FIG. **29**.

On the other hand, as shown in FIG. **30**, each of the disc holders **21a**, **21b**, **22a** and **22b** includes a slope **21a'**, **21b'**, **22a'** or **22b'**, which hangs over the projection area of the disc **100** and overlaps with the outer edge of the disc **100**. That is to say, the slope **21a'**, **21b'**, **22a'** or **22b'** has a downwardly tapered cross section and leans toward the disc **100** as shown in FIG. **30**. While the chucking and head openings **11c** and **11h** are covered with the shutters **21** and **22**, the slopes **21a'**, **21b'**, **22a'** and **22b'** are allowed to contact with the outer edge **100c** of the disc **100**, thereby gripping the disc **100** thereon and pressing the disc **100** in the thickness direction **100t**. As a result, the sheets **21p** and **22p** of the shutters **21** and **22** contact with the signal recording side **100A** of the disc **100** and the disc **100** is fixed in the cartridge body **10**. In such a state, the signal recording side **100A** of the disc **100** is in close contact with the sheets **21p** and **22p**. Thus, no dust will be deposited on the signal recording side **100A**.

Also, if the exposed side of the disc **100** is rotated manually or if the shutters **21** and **22** are opened or closed intentionally, then dust, finger marks or any other dirt that

has adhered onto the signal recording side **100A** of the disc **100** may be wiped away.

Furthermore, as shown in FIG. **31**, the shutter **21** includes a shutter opener/closer **21t**, an elastic portion **21v** and a locking protrusion **21k**. These portions **21t**, **21v** and **21k** form integral parts of the shutter **21**. Specifically, the shutter opener/closer **21t** is for use to open and close the shutter **21** externally. The locking protrusion **21k** is connected to the shutter **21** by way of the elastic portion **21v**. While the shutter **21** covers the chucking and head openings **11c** and **11h**, the locking protrusion **21k**, to which an elastic force is being applied from the elastic portion **21v**, engages with a locking hole **10k** of the cartridge body **10**, thereby preventing the shutter **21** from rotating and fixing the shutter **21** to the cartridge body **10** as shown in FIG. **31**. When the shutter **21** is fixed, the other shutter **22**, which is interlocked with the former shutter **21** via the interlocking mechanism **20c**, is also fixed.

Accordingly, only by getting the locking protrusion **21k** pressed externally by a protrusion, for example, in the

direction indicated by the arrow **20A** and disengaged from the locking hole **10k** while pressing the opener/closer **21t** in the direction indicated by the arrow **20B** at the same time, the shutters **21** and **22** can be rotated to expose the chucking and head openings **11c** and **11h** and the disc **100** can be released from the disc holders **21a, 21b, 22a** and **22b**. Thus, it is possible to prevent the user from removing the disc **100** accidentally.

Next, the structure and operation of the disc stoppers **23** will be described in further detail with reference to FIGS. **24** and **32**. FIG. **32** is a perspective view illustrating the removable disc stopper **23** upside down. The convex portions **23a, 23b** and **23c** of the disc stopper **23** are respectively engaged with concave portions **12a, 12b** and **12c** provided for the upper shell **12** near the disc window **12w** thereof as shown in FIG. **24**. Thus, if these convex portions **23a, 23b** and **23c** are disengaged from the concave portions **12a, 12b** and **12c**, the disc stopper **23** can be removed from the upper shell **12**.

Next, a mechanism for preventing the user from inserting this disc cartridge **308** into a disc drive in the wrong way

will be described with reference to FIG. **33**. FIG. **33** is a front view illustrating the insertion side of the disc cartridge **308** shown in FIG. **23** as viewed in the direction **1B** (see FIG. **23**). As shown in FIG. **33**, the cartridge body **10** includes a concave portion **10g** on one side surface thereof and is asymmetric in the direction **1A** in which the disc cartridge **308** is inserted into the disc drive (see FIG. **23**). The concave portion **10g** is not located at the center of thickness of the cartridge body **10**.

By providing such a concave portion **10g** for the disc cartridge **308**, only when its associated convex portion, provided for the disc drive, is fitted with this concave portion **10g**, the disc cartridge **308** can be inserted into the disc drive correctly and the disc drive can operate normally.

Stated otherwise, even if the user tries to insert the disc cartridge **308** into the disc drive upside down by mistake, he or she cannot insert the cartridge **308** into the disc drive. This is because the associated convex portion of the disc drive interferes with the other side surface of the disc cartridge **308** with no concave portion **10g**. Also, even if the

user tries to insert the disc cartridge **308** into the disc drive upside down and in the wrong way by mistake, he or she cannot insert the cartridge **308** into the disc drive, either. This is because the convex portion of the disc drive also interferes with the non-recessed portion of the side surface with the concave portion **10g**. Thus, it is possible to prevent the user from inserting the disc cartridge **308** erroneously.

The disc cartridge **308** of the eighth preferred embodiment described above may be modified in various manners.

For example, the thickness of the cartridge body **10** may be further reduced to such an extent that the disc stoppers **23** will not protrude from the upper surface **12f** of the upper shell **12** (see FIG. **24**) while the shutters **21** and **22** are closed. In that case, while the shutters **21** and **22** are going to be opened, the disc holders **21a** and **22a** may push the respective convex portions **23a** of the disc stoppers **23** upward from under the disc stoppers **23**, thereby protruding the disc stoppers **23** from the upper surface **12f** of the upper shell **12**. According to such a structure, a sufficiently broad space can

be allowed the disc **100** to rotate inside the disc storage portion **10d** and yet the disc cartridge **308** can have its thickness further reduced.

Also, the disc stoppers **23** may form integral parts of the cartridge body **10**. In that case, the disc stoppers **23** should be able to be bent almost perpendicularly so that the disc **100** mounted can be removed.

Furthermore, the shutter springs **31** and **32** may apply an elastic force in such a direction as to open the shutters **21** and **22**. If the shutters **21** and **22** can operate almost completely synchronously by way of the interlocking mechanism, one of the shutter springs **31** and **32** may be omitted.

In the preferred embodiment described above, the locking protrusion **21k** forms an integral part of the shutter **21.** Alternatively, a locking lever, including a locking protrusion and a convex portion at the end thereof, may be connected to the cartridge body **10** via an elastic portion, and an associated concave portion may be provided for the shutter so that the convex and concave portions engage with each other. In that case, by pressing the locking protrusion

through a locking hole of the cartridge body, these convex and concave portions may be disengaged from each other so as to allow the shutters to rotate freely. Optionally, in that alternative preferred embodiment, the locking lever, as well as the shutter springs (i.e., elastic members), may be resin springs that form integral parts of the cartridge body **10**.

EMBODIMENT 9

Hereinafter, a disc cartridge **309** according to a ninth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

As shown in FIGS. **34** and **35**, the disc cartridge **309** includes a lower shell **41**, an upper shell **42**, disc stoppers **42a**, **42b**, **42c** and **42d**, and a pair of shutters **51** and **52**.

As shown in FIG. **35**, the lower shell **41** includes a chucking opening **41c** and a head opening **41h**. The chucking opening **41c** allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **309** externally. The head opening **41h** allows a head, which reads and/or writes a signal from/on the signal recording side **100A**

of the disc **100**, to enter the disc cartridge **309** and access a target location on the disc **100**. The lower shell **41** faces the signal recording side **100A** of the disc **100**. Also, the head opening **41h** reaches one side surface of the lower shell **41**.

The upper shell **42** includes a circular disc window **42w**, through which the disc **100** can be introduced and removed into/from the disc cartridge **309** and which expands over the entire projection area of the disc **100** to expose the upper side of the disc **100**. The upper and lower shells **42** and **41** are adhered or welded together at their outer periphery, thereby forming a cartridge body **40**.

A disc storage portion **40d** for storing the disc **100** therein is defined by a first inner surface **41u** and a second inner surface **42i** of the cartridge body **40**. The first inner surface **41u** is opposed to the signal recording side **100A** of the disc **100**, while the second inner surface **42i** has a substantially cylindrical shape and defines the disc window **42w** inside. That is to say, the first inner surface **41u** is the bottom of the disc storage portion **40d**.

In the disc storage portion **40d**, a gap, which is wide

enough to allow the disc **100** to rotate freely, is provided between the second inner surface **42i** and the outer periphery of the disc **100**. Also, the top of the disc storage portion **40d** is the disc window **42w** so that the disc **100** stored in the disc storage portion **40d** has one of its sides exposed inside the disc window **42w**.

The disc stoppers **42a, 42b, 42c** and **42d** form integral parts of the upper shell **42** so as to partially protrude into the disc window **42w**. Each of these disc stoppers **42a, 42b, 42c** and **42d** is separated from the upper shell **42** via a slit. These disc stoppers **42a, 42b, 42c** and **42d** are used to prevent the disc **100** from dropping down from the disc window **42w**. The disc stoppers **42a, 42b, 42c** and **42d** are effective particularly when this disc cartridge **309** is loaded into a vertically mounted disc drive. Optionally, these disc stoppers **42a, 42b, 42c** and **42d** may be integrated with the upper shell **42** by way of elastic members.

The shutters **51** and **52** are disposed between the signal recording side **100A** of the disc **100** and the first inner surface **41u** of the cartridge body **40**. The shutters **51** and **52**

include holes **51u** and **52u**, respectively. These holes **51u** and **52u** are engaged in a freely rotatable state with shafts **41s**, which are located outside of the disc storage portion **40d** of the cartridge body **40** and on a deep side of the cartridge body **40** opposite to the head opening **41h** thereof. Thus, the shutters **51** and **52** rotate on the shafts **41s** in such a manner as to cover or expose the chucking and head openings **41c** and **41h**.

A cam **51c** and a follower **52c** are provided near the holes **51u** and **52u** of the shutters **51** and **52**, respectively. The cam **51c** and the follower **52c** have mutually engaging shapes and together make up an interlocking mechanism **50c** for opening and closing the shutters **51** and **52** while interlocking them with each other.

The respective upper surfaces of the shutters **51** and **52**, which are opposed to the signal recording side **100A** of the disc **100**, are covered with protective layers **51p** and **52p** for the purpose of preventing the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

The protective layers **51p** and **52p** may be appropriately

selected from the group consisting of anti-scratching nonwoven fabric, dustproof nonwoven fabric, anti-scratching coating and dustproof coating. In this preferred embodiment, sheets of a dustproof nonwoven fabric are adhered or ultrasonic welded as the protective layers **51p** and **52p** to the shutters **51** and **52**, respectively.

Shutter springs **61** and **62** are provided outside of the disc storage portion **40d** for the shutters **51** and **52**, respectively. These springs **61** and **62** apply an elastic force to the shutters **51** and **52** in such a direction as to close the shutters **51** and **52**. Alternatively, the shutter springs **61** and **62** may apply an elastic force to the shutters **51** and **52** in such a direction as to open the shutters **51** and **52**. Also, if the shutters **51** and **52** can operate almost completely synchronously by way of the interlocking mechanism, one of the shutter springs **61** and **62** may be omitted.

As in the eighth preferred embodiment described above, the shutters **51** and **52** each include two disc holders **51a, 51b** and **52a, 52b** at both ends thereof as shown in FIG. **35**. Furthermore, as will be described in detail later, convex

portions **51e** and **52e** are formed on the shutters **51** and **52,** respectively, so as to be located under the center hole of the disc **100** while the shutters **51** and **52** are closed.

As shown in FIG. **34,** the upper surface of the cartridge body **40** (or the upper shell **42**) has embossed arrow marks (or concave portions) **40a** that indicate the direction (the arrow **1A**) in which this disc cartridge **309** should be inserted into a disc drive. The cartridge body **40** further includes two concave portions **40c** on two of its side surfaces that are parallel to the direction **1A** in which the disc cartridge **309** is inserted into the disc drive. These concave portions **40c** may be used as either pull-in notches or positioning recesses when the disc cartridge **309** is pulled in and loaded into a disk drive or when the disc cartridge **309** is stored in a changer. Optionally, only one of the side surfaces of the disc cartridge **309** may include the concave portion **40c.** In that case, the concave portion **40c** can contribute to preventing the user from inserting or loading this disc cartridge **309** into the disc drive upside down by mistake. The upper surface of the cartridge body **40** further includes a grip

40e that allows the user to grip this disc cartridge **309**. This grip **40e** has an antislip embossed shape.

FIG. **36** is a perspective view illustrating the disc cartridge **309**, in which no disc **100** has been stored yet, to show a state where the shutters **51** and **52** cover the chucking and head openings **41c** and **41h**. FIG. **37** is a perspective view illustrating the disc cartridge **309**, in which no disc **100** has been stored yet, to show a state where the shutters **51** and **52** expose the chucking and head openings **41c** and **41h**.

Hereinafter, the structure and the operation of the shutters **51** and **52** will be described in further detail. As shown in FIGS. **34** and **35**, the disc holders **51a**, **51b**, **52a** and **52b** of the shutters **51** and **52** also have such a cross-sectional shape as including a slope that hangs over the projection area of the disc **100** and overlaps with the outer edge of the disc **100** as in the eighth preferred embodiment. That is to say, the slope is downwardly tapered and leans toward the disc **100**. Thus, the effects of the eighth preferred embodiment described above are also achieved by this ninth preferred embodiment.

Also, the shutter **52** includes an opener/closer **52t** for

use to open and close the shutter **52** externally, while the shutter **51** includes an elastic portion **51v** and a locking protrusion **51k** as integral parts thereof. The locking protrusion **51k** is connected to the shutter **51** by way of the elastic portion **51v** as shown in FIG. **35**. Thus, while the chucking and head openings **41c** and **41h** are covered with the shutters **51** and **52**, the locking protrusion **51k**, to which an elastic force is applied from the elastic portion **51v**, engages with a locking hole **40k** of the cartridge body **40** (or the lower shell **41**), thereby fixing the shutter **51** in a non-rotatable state to the cartridge body **40**. When the shutter **51** is fixed in this way, the other shutter **52**, which is interlocked with the shutter **51** via the interlocking mechanism **50c**, is also fixed.

Accordingly, only by getting the locking protrusion **51k** pressed externally by a protrusion, for example, in the direction indicated by the arrow **50A** and disengaged from the locking hole **40k** while pressing the opener/closer **52t** in the direction indicated by the arrow **50B** at the same time as shown in FIG. **36**, the shutters **51** and **52** can be rotated to expose

the chucking and head openings **41c** and **41h** and the disc **100** can be released from the disc holders **51a, 51b, 52a** and **52b**. Thus, it is possible to prevent the user from removing the disc **100** accidentally.

Unlike the eighth preferred embodiment described above, the locking protrusion **51k** and the opener/closer **52t** are provided in this preferred embodiment for the two different shutters **51** and **52**. Such a structure is particularly effective for a disc cartridge for a disc of a small size. This is because a disc cartridge for a disc of a small size and the shutters thereof should have relatively small sizes and it is normally difficult to provide the locking protrusion and opener/closer for a single shutter out of design considerations. Also, even when a single shutter can include both the locking protrusion and the opener/closer, a very narrow gap would be allowed between a shutter opening/closing mechanism and an unlocking mechanism on the disc drive side or these two mechanisms need to be formed within a very limited space, thus making it hard to design the disc drive as intended.

In the preferred embodiment described above, the locking protrusion **51k** forms an integral part of the shutter **51**. Alternatively, a locking lever, including a locking protrusion and a convex portion at the end thereof, may be connected to the cartridge body **40** by way of an elastic portion, and an associated concave portion may be provided for the shutter so that the convex and concave portions engage with each other. In that case, by pressing the locking protrusion through a locking hole of the cartridge body, these convex and concave portions may be disengaged from each other so as to allow the shutters to rotate freely. Optionally, in that alternative preferred embodiment, the locking lever, as well as the shutter springs (i.e., elastic members), may be resin springs that form integral parts of the cartridge body **40**.

Next, it will be described how the convex portions **51e** and **52e** on the shutters **51** and **52** work. FIG. **38** is a partial cross-sectional view of the disc cartridge **309**, which is viewed along a plane that passes the center of the disc **100**. As shown in FIG. **38**, while the shutters **51** and **52** are closed,

the convex portions **51e** and **52e** protrude into the center hole **100h** of the disc **100** and the disc **100** is now in contact with the shutters **51** and **52**.

As shown in FIG. **39**, while the shutters **51** and **52** are going to be opened, the convex portions **51e** and **52e** slide from inside the center hole **100h** into under the lower side of the disc **100**, thereby lifting the disc **100** up from the shutters **51** and **52**. In this manner, while the shutters **51** and **52** are going to be opened or closed, the signal recording side **100A** of the disc **100** will not get scratched by the shutters **51** and **52**. Also, it is inside the signal recording area of the signal recording side **100A** that the convex portions **51e** and **52e** move along with the shutters **51** and **52** being opened or closed. Accordingly, the convex portions **51e** and **52e** will not contact with, or scratch, the signal recording area.

Next, the structure and operation of the disc stoppers will be described with reference to FIGS. **40** and **41**. FIG. **40** is a partial cross-sectional view illustrating a portion of the disc cartridge **309** around the disc outer periphery, and is viewed along a plane that passes the center of the disc **100**.

As shown in FIG. **40**, a convex portion **42a'**, **42b'**, **42c'** or **42d'** has been formed on the bottom of the disc stopper **42a**, **42b**, **42c** or **42d**. While the shutters **51** and **52** are closed, the disc stopper **42a**, **42b**, **42c** or **42d** is substantially parallel to the surface of the disc **100** and falls within the thickness of the cartridge **309** as shown in FIG. **40**. An appearance of the disc cartridge **309** in such a state is illustrated in FIG. **36**.

On the other hand, while the shutters **51** and **52** are opened, the slopes **52f**, **51f**, **51d** and **52d** of the shutters **51** and **52** contact with the convex portions **42a'**, **42b'**, **42c'** and or **42d'**, respectively, thereby lifting the disc stoppers **42a**, **42b**, **42c** and **42d** to above the disc **100** as shown in FIG. **41**. An appearance of the disc cartridge **309** in such a state is illustrated in FIG. **37**. By using such a structure, particularly in an interval after the disc cartridge **309** has been vertically loaded into a disc drive and before the disc **100** is chucked, it is possible to prevent the disc **100** from dropping down from the cartridge **309**. In addition, while the disc **100** is being chucked, the disc **100** can move in a broader space. Furthermore, this structure can also contribute to

further reducing the thickness of the cartridge.

It should be noted that to keep the shutters **51** and **52** temporarily opened for a while, the slopes **52f, 51f, 51d** and **52d** may have convex or concave portions that engage with the convex portions **42a'**, **42b'**, **42c'** and **42d'**.

EMBODIMENT 10

Hereinafter, a disc cartridge **310** according to a tenth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings. The disc cartridge **310** of this preferred embodiment is mainly characterized in that disc stoppers are provided for the shutters.

As shown in FIGS. **42** and **43,** the disc cartridge **310** includes a lower shell **71,** an upper shell **72,** disc stoppers **81d, 81f,** and **82d**, and a pair of shutters **81** and **82**.

As shown in FIG. **43,** the lower shell **71** includes a chucking opening **71c** and a head opening **71h.** The chucking opening **71c** allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **310**

externally. The head opening **71h** allows a head, which reads and/or writes a signal from/on the signal recording side **100A** of the disc **100**, to enter the disc cartridge **310** and access a target location on the disc **100**. The lower shell **71** faces the signal recording side **100A** of the disc **100**. Also, the head opening **71h** reaches one side surface of the lower shell **71**.

The upper shell **72** includes a circular disc window **72w**, through which the disc **100** can be introduced and removed into/from the disc cartridge **310** and which expands over the entire projection area of the disc **100** to expose the upper side of the disc **100**. The upper and lower shells **72** and **71** are adhered or welded together at their outer periphery, thereby forming a cartridge body **70**.

A disc storage portion **70d** for storing the disc **100** therein is defined by a first inner surface **71u** and a second inner surface **72i** of the cartridge body **70**. The first inner surface **71u** is opposed to the signal recording side **100A** of the disc **100**, while the second inner surface **72i** has a substantially cylindrical shape and defines the disc window **72w** inside. That is to say, the first inner surface **71u** is

the bottom of the disc storage portion **70d**.

In the disc storage portion **70d**, a gap, which is wide enough to allow the disc **100** to rotate freely, is provided between the second inner surface **72i** and the outer periphery of the disc **100**. Also, the top of the disc storage portion **70d** is the disc window **72w** so that the disc **100** stored in the disc storage portion **70d** has one of its sides exposed inside the disc window **72w**.

The shutters **81** and **82** are disposed between the signal recording side **100A** of the disc **100** and the first inner surface **71u** of the cartridge body **70**. The shutters **81** and **82** include holes **81u** and **82u**, respectively. These holes **81u** and **82u** are engaged in a freely rotatable state with shafts **71s**, which are located outside of the disc storage portion **70d** of the cartridge body **70** and on a deep side of the cartridge body **70** opposite to the head opening **71h** thereof. Thus, the shutters **81** and **82** rotate on the shafts **71s** in such a manner as to cover or expose the chucking and head openings **71c** and **71h**.

A cam **81c** and a follower **82c** are provided near the holes

81u and **82u** of the shutters **81** and **82**, respectively. The cam **81c** and the follower **82c** have mutually engaging shapes and together make up an interlocking mechanism **80c** for opening and closing the shutters **81** and **82** while interlocking them with each other.

The respective upper surfaces of the shutters **81** and **82**, which are opposed to the signal recording side **100A** of the disc **100**, are covered with protective layers **81p** and **82p** for the purpose of preventing the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

The protective layers **81p** and **82p** may be appropriately selected from the group consisting of anti-scratching nonwoven fabric, dustproof nonwoven fabric, anti-scratching coating and dustproof coating. In this preferred embodiment, sheets of a dustproof nonwoven fabric are adhered or ultrasonic welded as the protective layers **81p** and **82p** to the shutters **81** and **82**, respectively.

Shutter springs **91** and **92** are provided outside of the disc storage portion **70d** for the shutters **81** and **82**, respectively. These springs **91** and **92** apply an elastic force

to the shutters **81** and **82** in such a direction as to close the shutters **81** and **82**. Alternatively, the shutter springs **91** and **92** may apply an elastic force to the shutters **81** and **82** in such a direction as to open the shutters **81** and **82**. Also, if the shutters **81** and **82** can operate almost completely synchronously by way of the interlocking mechanism **80c**, one of the shutter springs **91** and **92** may be omitted.

As in the eighth preferred embodiment described above, the shutters **81** and **82** each include two disc holders **81a, 81b** and **82a, 82b** at both ends thereof as shown in FIG. **43**. Convex portions **81e** and **82e** are also formed on the shutters **81** and **82**, respectively, as in the ninth preferred embodiment.

Furthermore, as will be described in detail later, the disc stoppers **81f, 81d** and **82d** are provided as integral parts of the shutters **81** and **82** near the disc holders **81a, 81b** and **82a**, respectively. Alternatively, these disc stoppers **81f, 81d** and **82d** may be integrated with the shutters **81** and **82** by way of elastic members.

As shown in FIG. **42**, the upper surface of the cartridge body **70** (or the upper shell **72**) has embossed arrow marks (or

concave portions) **70a** that indicate the direction (the arrow **1A**) in which this disc cartridge **310** should be inserted into a disc drive. The cartridge body **70** further includes two concave portions **70c** on two of its side surfaces that are parallel to the direction **1A** in which the disc cartridge **310** is inserted. These concave portions **70c** may be used as either pull-in notches or positioning recesses when the disc cartridge **310** is pulled in and loaded into a disk drive or when the disc cartridge **310** is stored in a changer. Optionally, only one of the side surfaces of the disc cartridge **310** may include the concave portion **70c**. In that case, the concave portion **70c** can contribute to preventing the user from inserting or loading this disc cartridge **310** into the disc drive upside down by mistake. The upper surface of the cartridge body **70** further includes a grip **70e** that allows the user to grip this disc cartridge **310**. This grip **70e** has an antislip embossed shape.

FIG. **44** is a perspective view illustrating the disc cartridge **310**, in which no disc **100** has been stored yet, to show a state where the shutters **81** and **82** cover the chucking

and head openings **71c** and **71h**. FIG. **45** is a perspective view illustrating the disc cartridge **310**, in which no disc **100** has been stored yet, to show a state where the shutters **81** and **82** expose the chucking and head openings **71c** and **71h**.

Hereinafter, the structure and the operation of the shutters **81** and **82** will be described in further detail. As shown in FIGS. **42** and **43**, the disc holders **81a, 81b, 82a** and **82b** of the shutters **81** and **82** have such a cross-sectional shape as including a slope that hangs over the projection area of the disc **100** and overlaps with the outer edge of the disc **100** as in the eighth preferred embodiment. That is to say, the slope is downwardly tapered and leans toward the disc **100**. Thus, the effects of the eighth preferred embodiment described above are also achieved by this tenth preferred embodiment.

Also, the shutter **82** includes an opener/closer **82t** for use to open and close the shutter **82** externally, an elastic portion **82v** and a locking protrusion **82k** as integral parts thereof. The locking protrusion **82k** is connected to the shutter **82** by way of the elastic portion **82v** as shown in FIG. **43**. Thus, while the chucking and head openings **71c** and **71h**

are covered with the shutters **81** and **82**, the locking protrusion **82k**, to which an elastic force is applied from the elastic portion **82v**, engages with a locking hole **70k** of the cartridge body **70** (or the lower shell **71**) as shown in FIG. **44**, thereby fixing the shutter **82** in a non-rotatable state to the cartridge body **70**. When the shutter **82** is fixed in this way, the other shutter **81**, which is interlocked with the shutter **82** via the interlocking mechanism **80c**, is also fixed.

Accordingly, only by getting the locking protrusion **82k** pressed externally by a protrusion, for example, in the direction indicated by the arrow **70A** and disengaged from the locking hole **70k** while pressing the opener/closer **82t** in the direction indicated by the arrow **70B** at the same time as shown in FIG. **44**, the shutters **81** and **82** can be rotated to expose the chucking and head openings **71c** and **71h** and the disc **100** can be released from the disc holders **81a**, **81b**, **82a** and **82b**. Thus, it is possible to prevent the user from removing the disc **100** accidentally.

In the preferred embodiment described above, the locking protrusion **82k** forms an integral part of the shutter **82**.

Alternatively, a locking lever, including a locking protrusion and a convex portion at the end thereof, may be connected to the cartridge body **70** by way of an elastic portion, and a concave portion may be provided for the shutter so that the convex and concave portions engage with each other. In that case, by pressing the locking protrusion through a locking hole of the cartridge body, these convex and concave portions may be disengaged from each other so as to allow the shutters to rotate freely. Optionally, in that alternative preferred embodiment, the locking lever, as well as the shutter springs (i.e., elastic members), may be resin springs that form integral parts of the cartridge body **70**.

Next, the structure and operation of the disc stoppers **81f**, **81d** and **82d** will be described in further detail. While the shutters **81** and **82** are closed, the disc stoppers **81f**, **81d** and **82d** are substantially parallel to the surface of the disc **100** and do not protrude from the upper surface of the disc cartridge **310** as shown in FIGS. **46** and **48**. An appearance of the disc cartridge **310** in such a state is illustrated in FIG. **44**.

On the other hand, while the shutters **81** and **82** are going to be opened, the disc stoppers **81f, 81d** and **82d** are guided by a slit **70s** and a slope **72s** of the cartridge body **70** so as to be lifted to above the disc **100** as shown in FIGS. **47** and **49**. The slit **70s** is formed in the inner sidewall of the cartridge body **70** as shown in FIG. **47,** while the slope **72s** is formed on the inner upper surface of the cartridge body **70** as shown in FIG. **49**. Also, the upper shell **72** is provided with notched portions **72a, 72b** and **72c** so as not to interfere with the disc stoppers **81f, 81d** and **82d** that have been lifted up. An appearance of the disc cartridge **310** in such a state is illustrated in FIG. **45**.

While the shutters **81** and **82** are closed, the disc stoppers **81f, 81d** and **82d** hang over the projection area of the disc **100** and overlap with the outer periphery of the disc **100**. Thus, the disc stoppers **81f, 81d** and **82d** press the disc **100** against the shutters **81** and **82** in the thickness direction, thereby holding it thereon. Accordingly, the disc holders **81a, 81b, 82a** and **82b** may be omitted from the shutters **81** and **82**.

By using such a structure, particularly in an interval after the disc cartridge **310** has been vertically loaded into a disc drive and before the disc **100** is chucked, it is possible to prevent the disc **100** from dropping down from the cartridge **310**. In addition, while the disc **100** is being chucked, the disc **100** can move in a broader space. Furthermore, this structure can also contribute to further reducing the thickness of the cartridge body.

EMBODIMENT 11

Hereinafter, a disc cartridge **311** according to an eleventh specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

As shown in FIGS. **50** and **51**, the disc cartridge **311** includes a lower shell **11**, an upper shell **12**, a pair of shutters **21** and **22** and disc stoppers **23**. As shown in FIGS. **52** through **56**, the structures and functions of all of these members are the same as those already described for the eighth preferred embodiment and the detailed description thereof will

be omitted herein.

Unlike the disc cartridge **308** of the eighth preferred embodiment described above, the shutters **21** and **22** of the disc cartridge **311** of the eleventh preferred embodiment have a hole **20h** as shown in FIGS. **50** and **51**.

More specifically, while the shutters **21** and **22** of the disc cartridge **311** are closed, the shutters **21** and **22** define the hole **20h** just under the center hole **100h** of the disc **100** as shown in FIG. **50**. As can be seen from FIG. **51**, the hole **20h** is made up of two notches **21h** and **22h** of the shutters **21** and **22**, respectively.

If the disc cartridge **311** is left with the upper side of the disc **100** exposed upward as shown in FIG. **50**, dust may pass through the center hole **100h** of the disc **100**. Even so, in this structure, the dust should pass and go out through the hole **20h** of the shutters **21** and **22** without remaining in the disc cartridge **311**, or without being deposited on the shutters **21** and **22**. Thus, when the shutters **21** and **22** are opened after that (i.e., when this disc cartridge **311** has been loaded into a disc drive), no dust will be deposited on the signal

recording side **100A** of the disc **100**.

The disc cartridge **311** may be left either upside up as shown in FIG. **50** or upside down (i.e., with the lower shell **11** facing upward). In view of these two possible positions, the hole **20h** preferably has a diameter that is approximately equal to that of the center hole **100h**. This is because if the holes **20h** and **100h** have approximately equal diameters, dust will be deposited neither on the shutters **21** and **22** when the disc cartridge **311** is left upside up nor on the signal recording side **100A** of the disc **100** when the disc cartridge **311** is left upside down.

In this disc cartridge **311**, the opener/closer **22t** for use to open and close the shutters **21** and **22** is provided for the shutter **22** unlike the eighth preferred embodiment described above. More specifically, as shown in FIGS. **51** and **57**, the opener/closer **22t**, elastic portion **22v** and locking protrusion **22k** are provided as integral parts of the shutter **22**. The locking protrusion **22k** is connected to the shutter **22** by way of the elastic portion **22v** as shown in FIG. **57**. Accordingly, unlike the eighth preferred embodiment described

above, the opener/closer **22t** is located on the right-hand side of the head opening **11h** with respect to the disc **100**. The opener/closer **22t** operates in the same way as the counterpart of the eighth preferred embodiment described above.

EMBODIMENT 12

Hereinafter, a disc cartridge **312** according to a twelfth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

Unlike the disc cartridge **311** of the eleventh preferred embodiment described above, the disc cartridge **312** of this twelfth preferred embodiment includes a rim **12t** around the inner side surface **12i** of the cartridge body **10** and a ring **20w** around the hole **20h** defined by the shutters **21** and **22**. These features will be described below.

As shown in FIG. **58,** the rim **12t** protrudes from the inner side surface **12i** of the upper shell **12** toward the inner periphery of the disc **100** and substantially surrounds the outer periphery of the disc storage portion **10d**. FIG. **59** shows a cross section of the disc cartridge **312** in a state

where the disc **100** is stored in the disc storage portion **10d.** While the shutters **21** and **22** are closed, the outer edge of the signal recording side **100A** of the disc **100** contacts with the rim **12t** as shown in FIG. **59.** As a result, the gap between the outer periphery of the disc **100** and the cartridge body **10** is closed, thereby preventing dust from reaching the signal recording side **100A** of the disc **100.**

Also, a gap **10w** is provided between the rim **12t** of the cartridge body **10** and the lower shell **11.** Thus, when the shutters **21** and **22** are opened, respective portions of the shutters **21** and **22** enter the gap **10w** as shown in FIGS. **60** and **61,** thereby preventing the shutters **21** and **22** from interfering with the cartridge body **10.**

In such a structure, however, while the shutters **21** and **22** are closed, another gap **10z** that leads to the open air is also created between the disc **100** and the shutters **21** and **22** as shown in FIG. **59.** To close this gap **10z,** the shutters **21** and **22** include convex portions **21w** and **22w,** respectively, around the center hole **100h** of the disc **100.** As shown in FIG. **58,** when the shutters **21** and **22** are closed, these two convex

portions **21w** and **22w** are in tight contact with each other, thereby forming the ring **20w** that closes the gap **10z** around the disc center hole **100h**. As a result, no dust will reach the signal recording side **100A** of the disc **100** through the disc center hole **100h**.

However, the top of these convex portions **21w** and **22w** might contact with the signal recording side **100A** of the disc **100**. Accordingly, the edge of the convex portions **21w** and **22w** should preferably be round so as not to scratch the signal recording side **100A** of the disc **100**. Optionally, the convex portions **21w** and **22w** may form integral parts of the shutters **21** and **22**, respectively. In that case, an anti-scratching nonwoven fabric is preferably adhered or ultrasonic welded to that portion of the ring **20w** that contacts with the signal recording side **100A** of the disc **100** or an anti-scratching coating is preferably formed on that portion. Alternatively, the convex portions **21w** and **22w** themselves may be made of an anti-scratching nonwoven fabric or an anti-scratching coating and directly adhered or ultrasonic welded to the shutters **21** and **22**, respectively.

Also, as shown in FIG. **59**, while the shutters **21** and **22** are closed, the disc **100** is lifted by the ring **20w** and the rim **12t** over the shutters **21** and **22** with the gap **10z** left between them. That is to say, most of the signal recording side **100A** of the disc **100** is not in contact with the shutters **21** and **22**. Accordingly, even if the surface of the shutters **21** and **22** is not covered with an anti-scratching nonwoven fabric, for example, the signal recording side **100A** still will not get scratched.

FIGS. **62** and **63** illustrate a disc cartridge including alternative convex portions **21w′** and **22w′** that have been expanded toward the outer periphery of the disc **100**. Specifically, FIG. **62** illustrates a state in which the shutters **21** and **22** are closed, while FIG. **63** illustrates a state in which the shutters **21** and **22** are opened.

As shown in FIGS. **62** and **63**, while the shutters **21** and **22** are opened, the convex portions **21w′** and **22w′** are preferably located inside the rim **12t** of the disc storage portion **10d** (i.e., closer to the center of the disc storage portion **10d**). Then, the convex portions **21w′** and **22w′** will not contact with,

or interfere with, the rim **12t**.

Optionally, the convex portions **21w′** and **22w′** may form integral parts of the shutters **21** and **22**, respectively. In that case, an anti-scratching nonwoven fabric is preferably adhered or ultrasonic welded to those portions of the convex portions **21w′** and **22w′** that contact with the disc **100** or an anti-scratching coating is preferably formed thereon. Alternatively, the convex portions **21w′** and **22w′** themselves may be made of an anti-scratching nonwoven fabric or an anti-scratching coating and directly adhered or ultrasonic welded to the shutters **21** and **22**, respectively.

EMBODIMENT 13

Hereinafter, a disc cartridge **313** according to a thirteenth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

First, the structure of the disc cartridge **313** will be outlined with reference to FIGS. **64** and **65**. As in the eighth preferred embodiment, the disc **100** shown in FIGS. **64** and **65**

also includes first and second sides. The first side of the disc **100**, on which its label is normally printed, is illustrated in FIG. **64**, while the second side thereof, i.e., the signal recording side **100A**, is illustrated as the backside in FIG. **65**.

As shown in FIGS. **64** and **65**, the disc cartridge **313** includes a lower shell **11**, an upper shell **12**, a pair of shutters **21** and **22** and disc stoppers **23**.

As shown in FIG. **65**, the lower shell **11** includes a chucking opening **11c** and a head opening **11h**. The chucking opening **11c** allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **313** externally. The head opening **11h** allows a head, which reads and/or writes a signal from/on the signal recording side **100A** of the disc **100**, to enter the disc cartridge **313** and access a target location on the disc **100**. The lower shell **11** faces the signal recording side **100A** of the disc **100**. The lower shell **11** is formed by molding a synthetic resin into a predetermined shape.

The head opening **11h** reaches one side surface of the

lower shell **11**. To minimize a decrease in rigidity of the lower shell **11** due to the presence of the head opening **11h**, the lower shell **11** includes a bridge **11b** that links both ends of the head opening **11h** together. The lower shell **11** further includes two positioning holes **11w** that engage with cartridge positioning pins (not shown) of a disc drive.

The upper shell **12** includes a circular disc window **12w**, through which the disc **100** can be introduced and removed into/from the disc cartridge **313** and which expands over the entire projection area of the disc **100** to expose the upper side of the disc **100**. The upper and lower shells **12** and **11** are adhered or welded together at their outer periphery, thereby forming a cartridge body **10**. The upper shell **12** is also made of a synthetic resin.

A disc storage portion **10d** for storing the disc **100** therein is defined by an inner lower surface **11u** and an inner side surface **12i** of the cartridge body **10**. The inner lower surface **11u** is opposed to the signal recording side **100A** of the disc **100**, while the inner side surface **12i** has a substantially cylindrical shape and defines the disc window

12w inside. That is to say, the inner lower surface **11u** is the bottom of the disc storage portion **10d**.

In the disc storage portion **10d**, a gap, which is wide enough to allow the disc **100** to rotate freely, is provided between the inner side surface **12i** and the outer periphery of the disc **100**. Also, the top of the disc storage portion **10d** is the disc window **12w** so that the disc **100** stored in the disc storage portion **10d** has one of its sides exposed inside the disc window **12w**.

Two removable disc stoppers **23** are provided for the upper shell **12** so as to partially protrude into the disc window **12w** as shown in FIGS. **64** and **65**. A third disc stopper **12s** is further provided for the upper shell **12** so as to protrude into the disc window **12w**. The third disc stopper **12s** forms an integral part of the upper shell **12**. These three disc stoppers **23** and **12s** are arranged substantially at regular intervals around the circumference of the disc window **12w** for the purpose of preventing the disc **100** from dropping down from the disc window **12w**. Also, two convex disc contact portions **12s'** are formed on the disc stopper **12s**. For the disc **100**,

these disc contact portions **12s'** are almost as high as the disc contact portions **23a** of the disc stoppers **23**.

According to this structure, even if the disc cartridge **313** is mounted vertically or upside down, the disc cartridge **313** still can hold the disc **100** without dropping it. That is to say, when the disc cartridge **313** is inserted vertically or upside down into a disc drive, this disc cartridge **313** can particularly effectively prevent the disc **100** from dropping down. It should be noted that the disc stoppers **23** do not have to be removable from the cartridge body **10**. Alternatively, as long as the disc stoppers **23** can be rotated or bent inside the disc storage portion **10d** to such an extent as to allow the user to remove the disc **100** from the cartridge body **10**, the disc stoppers **23** may also be secured to the upper shell **12**.

The shutters **21** and **22** lie on a single plane between the signal recording side **100A** of the disc **100** and the inner lower surface **11u** of the cartridge body **10**. The shutters **21** and **22** include holes **21u** and **22u**, respectively. These holes **21u** and **22u** are engaged in a freely rotatable state with shafts **11s**,

which are located outside of the disc storage portion **10d** of the cartridge body **10** and on a deep side of the cartridge body **10** opposite to the head opening **11h** thereof. Thus, the shutters **21** and **22** rotate on the shafts **11s** in such a manner as to cover or expose the chucking and head openings **11c** and **11h**. The shutters **21** and **22** are also made of a synthetic resin.

A ring portion **21c** and a pin portion **22c** are provided near the holes **21u** and **22u** of the shutters **21** and **22**, respectively. The ring portion **21c** and the pin portion **22c** have mutually engaging shapes and together make up an interlocking mechanism **20c** for opening and closing the shutters **21** and **22** while interlocking them with each other. The interlocking mechanism **20c** may also be implemented as a cam mechanism or a gear mechanism.

The respective upper surfaces of the shutters **21** and **22**, which are opposed to the signal recording side **100A** of the disc **100**, are covered with protective layers **21p** and **22p** for the purpose of preventing the signal recording side **100A** of the disc **100** from getting scratched or attracting dust.

The protective layers **21p** and **22p** may be appropriately selected from the group consisting of anti-scratching nonwoven fabric, dustproof nonwoven fabric, anti-scratching coating and dustproof coating. In this preferred embodiment, sheets of a dustproof nonwoven fabric are adhered or ultrasonic welded as the protective layers **21p** and **22p** to the shutters **21** and **22**, respectively.

A locking protrusion **21k** is provided for the shutter **21**, while a locking engaging portion **22k**, which engages with the locking protrusion **21k**, is provided for the shutter **22**. The locking protrusion **21k** and locking engaging portion **22k** together make up a locking mechanism **20k** for locking and unlocking the shutters **21** and **22** to/from each other. By using this mechanism **20k**, the shutters **21** and **22** can be locked and unlocked automatically, thus preventing the user from opening the shutters **21** and **22** accidentally. In addition, the signal recording side **100A** of the disc **100** can be protected from dust, finger marks or scratches. The locking protrusion **21k** and the locking engaging portion **22k** form integral parts of the shutters **21** and **22**, respectively.

Furthermore, the shutters **21** and **22** are provided with notches **21h** and **22h**, respectively. When the shutters **21** and **22** are closed, these notches **21h** and **22h** contact with each other to form a hole **20h** just under the center hole **100h** of the disc **100**. In this case, the diameter of the hole **20h** is approximately equal to that of the center hole **100h** of the disc **100**. In such a structure, even if this disc cartridge **313** is left with the upper side of the disc **100** exposed upward, no dust will be deposited on the shutters **21** and **22**. Also, even if the disc cartridge **313** is left upside down, no dust will be directly deposited on the signal recording side **100A** of the disc **100**, either.

As already described for the eighth preferred embodiment, the shutters **21** and **22** each include two disc holders **21a, 21b** and **22a, 22b** at both ends thereof. These disc holders **21a, 21b, 22a** and **22b** are arranged substantially at regular intervals around the circumference of the disc **100**. The disc holders **21a, 21b, 22a** and **22b** form integral parts of the shutters **21** and **22**. Each of these disc holders **21a, 21b, 22a** and **22b** has a downwardly tapered cross-sectional shape (or

slope) to grip the outer edge of the disc **100** thereon when the shutters **21** and **22** are closed. By providing these slopes, the disc **100** can be held firmly and pressed against the shutters **21** and **22** while the shutters **21** and **22** are closed.

In this preferred embodiment, only the disc holder **21b** is not secured to the shutter **21** but is connected thereto via an elastic portion **21d** and is freely rotatable in the radial direction of the disc **100** (i.e., toward the center of the disc **100**). Accordingly, the disc holders **21a, 21b, 22a** and **22b** can firmly hold a disc **100** having any of various diameters or thicknesses without allowing the disc **100** to move inconstantly.

A shutter opener/closer **22t** for use to open and close the shutter **22** is formed as an integral part of the shutter **22** on the front side of the disc cartridge **313** opposite to the hole **22u**, i.e., near the disc holder **22a**. When the shutters **21** and **22** are attached to the cartridge body **10**, the shutter opener/closer **22t** is located under the bridge **11b** and inside the head opening **11h**. In opening or closing the shutters **21** and **22**, the opener/closer **22t** is moved along the bridge **11b** inside the head opening **11h**. In this arrangement, there is no

need to separately provide any gap for allowing the shutter opener/closer **21t** to move therein for the cartridge body **10.** In other words, since there is no need to provide an extra gap for the cartridge body **10,** no dust will enter the cartridge body **10** unnecessarily. Furthermore, the shutter opener/closer **22t** can be disposed inside the head opening **11h** of the cartridge body **10,** thus providing a cartridge of a simplified good design.

As shown in FIG. **66,** when closed, the shutters **21** and **62** are not entirely in contact with each other along a line but have a plurality of contact portions that are not aligned with the line. More specifically, the shutters **21** and **22** have a first pair of contact portions **21f** and **22f** over the chucking opening **11c** and a second pair of contact portions **21g** and **22g** over the head opening **11h,** respectively. In this preferred embodiment, the contact portions **21f** and **22f** contact with each other along the centerline of the disc cartridge **313**. On the other hand, the contact portions **21g** and **22g** contact with each other along a line that defines a predetermined angle (e.g., approximately 15 degrees to approximately 16 degrees) with the

centerline of the disc cartridge **313**. When the shutters **21** and **22** have such shapes, the shutter **22** can have an integral shape from the vicinity of the shutter opener/closer **22t** and can exhibit sufficiently high rigidity.

Shutter springs **31** and **32** are provided outside of the disc storage portion **10d** for the shutters **21** and **22**, respectively. These springs **31** and **32** apply an elastic force to the shutters **21** and **22** in such a direction as to close the shutters **21** and **22**. The shutter springs **31** and **32** are inserted into two spring poles **11t** on the inner lower surface **11u** of the cartridge body **10**. In this preferred embodiment, torsion coil springs are used as the shutter springs **31** and **32**. The torsion coil springs **31** and **32** preferably have the same shape to reduce the cost. Examples of other elastic members that may be used as the shutter springs **31** and **32** include compression springs, leaf springs and elastic resin springs.

As shown in FIG. **65**, the disc cartridge **313** includes a write protector **40**, which is inserted into a groove **11v** of the lower shell **11** so as to slide along the groove **11v**. By sliding the write protector **40**, the convex portion **40t** can be

moved, thereby turning ON or OFF a sensor switch provided for a disc drive. In this manner, writing on the disc **100** may be either prohibited or allowed.

That is to say, this disc cartridge **313** is made up of the cartridge body **10** consisting of the lower and upper shells **11** and **12**, disc stoppers **23**, shutters **21** and **22**, shutter springs **31** and **32**, and write protector **40**.

When the lower and upper shells **11** and **12** are joined together, the two shafts **11s** of the lower shell **11** are engaged with two concave portions **12h** of the upper shell **12**. In this manner, the shafts **11s** can have their rigidity increased. Thus, even when the shutters **21** and **22** are open, reduced torsion is created at the respective centers of rotation of the shutters **21** and **22** by the elastic force applied from the shutter springs **31** and **32**. As a result, the shutters **21** and **22** can be opened to the intended angle.

As shown in FIG. **64**, the upper surface of the cartridge body **10** (or the upper shell **12**) has a label plane **10f**, on which the user can note down the contents of the disc **100** stored, and an embossed arrow mark (or concave portion) **10a**

that indicates the direction (the arrow **1A**) in which this disc cartridge **313** should be inserted into a disc drive.

The cartridge body **10** further includes two pairs of concave portions **10c** and **10e** on two of its side surfaces that are parallel to the direction **1A** in which the disc cartridge **313** is inserted. These concave portions **10c** and **10e** may be used as either pull-in notches or positioning recesses when the disc cartridge **313** is pulled in and loaded into a disk drive or when the disc cartridge **313** is stored in a changer. The cartridge body **10** further includes a slit **10b** on one of its side surfaces. The slit **10b** may be used as a recess to identify the upside and downside of the disc cartridge **313** from each other when this disc cartridge **313** is inserted into the disc drive.

Hereinafter, it will be described with reference to FIGS. **66, 67, 68** and **69** how this disc cartridge **313** operates. FIGS. **66** and **67** are plan views illustrating the disc cartridge **313** in a state where its shutters **21** and **22** are closed and in a state where its shutters **21** and **22** are opened, respectively. FIG. **68** is a plan view illustrating the details of the shutter

locking mechanism **20k**. And FIG. **69** is a cross-sectional view illustrating the details of the disc holder **22a** of the shutter **22**.

First, a storage state of the disc cartridge **313**, i.e., a state of the disc cartridge **313** that has not been loaded into a disc drive yet, will be described. In that state, the shutters **21** and **22** are closed as shown in FIG. **66**. Also, as shown in FIG. **69**, the slope **22a'** of the disc holder **22a** of the shutter **22** contacts with the outer edge of the disc **100**, thereby holding the disc **100** thereon and pressing the disc **100** in the thickness direction **100t**. As a result, the signal recording side **100A** of the disc **100** is brought into contact with the sheet **22p** of the shutter **22** and the disc **100** is fixed in the cartridge body **10**. The three other disc holders **21a**, **21b** and **22b** also have their own slopes **21a'**, **21b'** and **22b'**, respectively. Thus, just like the disc holder **22a**, these disc holders **21a**, **21b** and **22b** also hold and fix the disc **100** in the cartridge body **10**.

In this state, the signal recording side **100A** of the disc **100** is in close contact with the sheets **21p** and **22p**.

Thus, no dust will be deposited on the signal recording side **100A**. Also, if the exposed side of the disc **100** is rotated manually or if the shutters **21** and **22** are opened or closed intentionally, then dust, finger marks or any other dirt that has adhered onto the signal recording side **100A** of the disc **100** may be wiped away.

Furthermore, since the shutters **21** and **22** are locked by the locking mechanism **20k**, the user cannot open the shutters **21** and **22** accidentally. Thus, the signal recording side **100A** of the disc **100** can be protected from dust, finger marks or scratches.

Furthermore, the shutters **21** and **22** are provided with notches **21h** and **22h**, respectively. When the shutters **21** and **22** are closed, these notches **21** and **22** contact with each other to form a hole **20h** just under the center hole **100h** of the disc **100**. In such a structure, even if this disc cartridge **313** is left with the upper side of the disc **100** exposed upward, dust will pass through the center hole **100h** but will not be deposited on the shutters **21** and **22**.

Also, while the shutters **21** and **22** are closed, at least

the two pairs of contact portions **21f, 22f** and **21g, 22g** of the shutters **21** and **22,** which are butted with each other over the chucking and head openings **11h** and **11c,** respectively, each overlap with each other in the thickness direction of the disc **100** as shown in FIGS. **70** and **71.** Accordingly, even if the shutters **21** and **22** have been closed incompletely because a disc **100** having a non-regular diameter has been mounted on this disc cartridge **313** or because the shutters **21** and **22** have not been locked completely, no gap will be created between the contact portions of the shutters **21** and **22.** Thus, even in such a situation, the disc **100** can also be protected from dust, finger marks or scratches.

Also, as shown in FIG. **70,** the shutters **21** and **22** are in contact with each other around the head opening **11h** so that the contact portion **22g** of the shutter **22** is located over the contact portion **21g** of the shutter **21.** On the other hand, as shown in FIG. **71,** the shutters **21** and **22** are in contact with each other around the chucking opening **11c** so that the contact portion **21f** of the shutter **21** is located over the contact portion **22f** of the shutter **22.** In this manner, the angle

defined by one of multiple contact portions **21f** or **21g** or **22f** or **22g** of the shutter **21** or **22** may be different from the angle defined by another one of the contact portions **21g** or **21f** or **22g** or **22f** of the shutter **21** or **22**. In such a structure, the two shutters **21** and **22** can be tightly engaged with each other in the thickness direction of the disc **100**. Thus, neither the shutter **21** nor the shutter **22** will be raised unintentionally. In addition, while the shutters **21** and **22** are closed, the contact portions of the shutters **21** and **22** can exhibit increased rigidity.

In this preferred embodiment, the shutters **21** and **22** have the contact portions **21f**, **21g**, **22f** and **22g** shown in FIGS. **70** and **71**. However, the shutters **21** and **22** may also have contact portions at different locations or may contact with each other in a different manner. For example, the contact portions **21g** and **22g** shown in FIG. **70** may be shifted to a location around the head opening **11h** or the contact portions **21f** and **22f** shown in FIG. **71** may be shifted to a location around the chucking opening **11c**. Then, the shutters **21** and **22** can exhibit even higher rigidity when closed, and the gap

between the contact portions can be further reduced, thus preventing the dust from entering the inside of the cartridge.

Also, while the shutters **21** and **22** are closed, convex portions **21j** and **22j**, provided for the shutters **21** and **22** as shown in FIG. **68**, are in contact with two shutter stoppers **12f** provided for the upper shell **12** as shown in FIG. **65**. Accordingly, the shutters **21** and **22** have its rotation regulated and cannot move from their locked positions. As a result, the shutters **21** and **22** will not move inconstantly in their locked state. In addition, it is possible to prevent the user from breaking the shutters **21** and **22** intentionally. Furthermore, since the shutters **21** and **22** have their rotation regulated, the shutter opener/closer **22t** is not displaced. Accordingly, when this disc cartridge **313** is loaded into a disc drive, the shutter opener/closer **22t** can be engaged with the shutter opening/closing mechanism of the disc drive just as intended.

Hereinafter, it will be described how this disc cartridge **313** is loaded into the disc drive. As shown in FIG. **66**, when the disc cartridge **313** is inserted into the disc

drive in the direction **1A**, the cartridge positioning pins of the disc drive engage with the positioning holes **11w** of the disc cartridge **313**, thereby determining the horizontal and vertical positions of the disc cartridge **313** inside the disc drive.

Next, a shutter opener/closer of the shutter opening/closing mechanism provided inside the disc drive engages with the shutter opener/closer **22t** shown in FIG. **68**. At the same time, an unlocking member of the shutter opening/closing mechanism presses an unlocking portion **21y**, which is connected to the shutter **21** by way of an elastic portion **21e**, in the direction **20A**. As a result, the locking protrusion **21k** of the locking mechanism **20k** is disengaged from the locking engaging portion **22k** thereof, thereby unlocking the shutters **21** and **22** from each other. In such a state, the shutter opener/closer of the shutter opening/closing mechanism moves the shutter opener/closer **22t** in the direction indicated by the arrow **20B**. Consequently, the shutter **21** rotates on the shaft **11s** while dominating the elastic force applied from the shutter spring **31** as shown in FIG. **67**. Synchronously with the

movement of the shutter **21**, the other shutter **22**, which is interlocked with the former shutter **21** via the interlocking mechanism **20c**, also rotates while dominating the elastic force applied from the shutter spring **32**. Accordingly, when the shutter **21** has been opened, the shutter **22** will have also been opened.

By the time the shutters **21** and **22** are opened completely, the locking protrusion **21k** and the unlocking portion **21y** will have returned to their home positions along with the elastic portion **21e**. Thus, the elastic portion **21e** made of a resin is not deformed plastically. In this manner, the signal recording side **100A** of the disc **100** is exposed through the chucking and head openings **11c** and **11h**. Also, the disc **100**, which has been held by the disc holders **21a**, **21b**, **22a** and **22b**, is released therefrom as the shutters **21** and **22** rotate. As a result, the disc **100** is now freely rotatable inside the disc storage portion **10d**.

Subsequently, the spindle motor and the turntable of the disc drive enter the chucking opening **11c** and the head of the disc drive enters the head opening **11h**. Consequently, the

disc drive is now ready to perform a read or write operation on the disc **100** loaded.

As described above, only by getting the locking protrusion **21k** pressed externally by a protrusion, for example, in the direction indicated by the arrow **20A** and disengaged from the locking engaging portion **22k** while pressing the shutter opener/closer **22t** in the direction indicated by the arrow **20B** at the same time, the shutters **21** and **22** can be rotated to expose the chucking and head openings **11c** and **11h** and the disc **100** can be released from the disc holders **21a**, **21b**, **22a** and **22b**. Thus, it is possible to prevent the user from opening the shutters **21** and **22** or removing the disc **100** accidentally. As a result, the disc **100** can be protected from dust, finger marks or scratches.

Hereinafter, it will be described how the disc cartridge **313** is ejected from the disc drive. When an ejecting mechanism of the disc drive starts to operate, the shutter opener/closer of the disc drive, which has been engaged with the shutter opener/closer **22t**, disengages itself from the shutter opener/closer **22t**. As a result, the shutters **21** and **22** cannot

be kept opened and start to rotate in the opposite direction. That is to say, the shutters **21** and **22**, to which an elastic force is being applied from the shutter springs **31** and **32** in such a direction as to close the shutters **21** and **22**, start to close themselves. Consequently, the shutters **21** and **22** close up the head and chucking openings **11h** and **11c**. In this case, the shutters **21** and **22** are locked to each other by the locking mechanism **20k**. In the meantime, the disc **100** gets held by the disc holders **21a**, **21b**, **22a** and **22b** again to recover its original state. Then, the disc cartridge **313** is ejected from the disc drive.

In the disc cartridge **313**, the disc contact portion **23a** of the disc stoppers **23** provided for the cartridge body **10** and the disc contact portion **12s'** of the upper shell **12** are located at the same vertical level as shown in FIG. **69**. Also, the top of the slopes **21a'**, **21b'**, **22a'** and **22b'** of the disc holders **21a**, **21b**, **22a** and **22b** of the shutters **21** and **22** is higher in level than the bottom of the disc contact portions **23a** and **12s'** in the direction **100u** in which the disc **100** is movable. Accordingly, even if the disc cartridge **313** is loaded

into a disc drive either vertically or upside down, the shutters **21** and **22** still can hold the disc **100** firmly thereon. For example, if the disc cartridge **313** is loaded upside down into a disc drive, the disc **100** that is no longer chucked contacts with the disc contact portions **23a** and **12s'** and still can maintain its horizontal position. And when the shutters **21** and **22** are closed in such a state, the disc **100** contacts with the slopes **21a'**, **21b'**, **22a'** and **22b'** this time. Then, the disc **100** will slide along the slopes **21a'**, **21b'**, **22a'** and **22b'** smoothly to be held firmly by the disc holders **21a, 21b, 22a** and **22b**.

In the disc cartridge of the thirteenth preferred embodiment described above, the cartridge body thereof has a disc window and covers only one side of the disc. Also, the disc cartridge includes a shutter opener/closer inside a head opening of the cartridge body, and therefore, there is no need to provide an unnecessary gap for the cartridge body. As a result, no dust will enter the inside of the cartridge body.

In addition, in the disc cartridge of this thirteenth preferred embodiment, the two shutters thereof are made to

contact with each other along the centerline of the disc over the chucking opening and along a line, which defines a predetermined angle with the centerline, over the head opening. Accordingly, these shutters can have an integrated structure from the vicinity of the shutter opener/closer and can exhibit sufficiently high rigidity.

Furthermore, since the two shutters are locked or unlocked to/from each other, the user cannot open or close the shutters accidentally. Thus, the disc can be protected from dust, finger marks or scratches.

Moreover, at least one of multiple disc holders of the disc cartridge is not secured to its associated shutter but is just connected thereto via an elastic portion. As an elastic force is also applied from a shutter spring to that disc holder, the disc holder can be deformed sufficiently elastically in the disc radial direction. For that reason, even if a disc of a non-regular size has been mounted on this disc cartridge, the disc cartridge can also hold such a disc firmly without allowing it to move inconstantly.

EMBODIMENT 14

Hereinafter, a disc cartridge **314** according to a fourteenth specific preferred embodiment of the present invention will be described with reference to FIGS. **72** through **81**. In FIGS. **72** through **81**, each member of the disc cartridge **314** of the fourteenth preferred embodiment, having substantially the same function as the counterpart of the disc cartridge **313** of the thirteenth preferred embodiment described above, is identified by the same reference numeral.

The disc cartridge **314** of the fourteenth preferred embodiment is different from the disc cartridge **313** of the thirteenth preferred embodiment described above in the respective shapes of the inner upper surface **12u** of the cartridge body **10** (see FIG. **79**), the disc holders **21a, 21b, 22a** and **22b** (see FIGS. **72** through **79**) and the disc stoppers **53** (see FIGS. **72, 77** and **78**). In addition, the disc cartridge **314** further includes a disc supporting portion **60** (see FIGS. **72** and **81**). Thus, the following description of the disc cartridge **314** of the fourteenth preferred embodiment of the present invention will be focused on these differences.

In the disc cartridge **313** of the thirteenth preferred embodiment described above, the respective tops of the disc holders **21a, 21b, 22a** and **22b** thereof are located at substantially the same vertical levels along the outer periphery of the disc **100.** In contrast, in the disc cartridge **314** of this fourteenth preferred embodiment, protrusions are formed on predetermined areas of the disc holders **21b, 22a** and **22b** as shown in FIGS. **73** and **79.** More specifically, as shown in FIG. **79,** each of these three disc holders **21b, 22a** and **22b** includes: a first portion **121b, 122a** or **122b** that has a protrusion thereon and has a first height **h1** as measured from the upper surface of the shutters **21** and **22**; and a second portion **221b, 222a** or **222b** that has a second height **h2** as measured from the upper surface of the shutters **21** and **22.** The other disc holder **21a** consists of a second portion **221a** that has the second height **h2.**

The first height **h1** is greater than the second height **h2** and is approximately equal to the height (i.e., the vertical level of the upper surface) of the disc holders **21a, 21b, 22a** and **22b** of the disc cartridge **313** of the thirteenth preferred

embodiment described above. That is to say, the disc holders **21a, 21b, 22a** and **22b** of this fourteenth preferred embodiment are lower than the counterparts of the disc cartridge **313** of the thirteenth preferred embodiment except their first portions **121b, 122a** and **122b.**

Also, as shown in FIGS. **74** and **75,** a stepped protrusion **223** is formed on the upper surface of the first portion **122a** of the disc holder **22a.** The stepped protrusion **223** has two vertical levels, the higher one of which is closer to the disc **100** mounted. A similar stepped protrusion is also formed on the upper surface of the first portion **121b** of the disc holder **21b** and on the upper surface of the first portion **122b** of the disc holder **22b.**

As the shutter **21** or **22** is getting closed, the first portion **121b, 122a** or **122b** of the disc holder **21b, 22a** or **22b** contacts with the disc **100** earlier than any other portion thereof (i.e., earlier than the second portion **221b, 222a** or **222b** thereof).

The disc holders **21a, 21b, 22a** and **22b** move as the shutters **21** and **22** are opened or closed. FIG. **77** illustrates

the respective positions of the disc holders **21a, 21b, 22a** and **22b** while the shutters **21** and **22** are closed. On the other hand, FIG. **78** illustrates the respective positions of the disc holders **21a, 21b, 22a** and **22b** while the shutters **21** and **22** are opened. FIGS. **79** and **80** are cross-sectional views illustrating portions of the disc cartridge **314** that are respectively taken along the lines **B-B** and **C-C** shown in FIG. **78**.

As shown in FIGS. **77, 78** and **79**, the regions **12y, 12x** and **12z** on the inner upper surface **12u** of the cartridge body **10**, through which the first portions **121b, 122a** and **122b** of the disc holders **21b, 22a** and **22b** pass as the shutters **21** and **22** are opened or closed, are recessed. On the other hand, the regions **12y′**, **12x′** and **12z′**, through which the second portions **221b, 222a** and **222b** thereof pass, are not recessed. Accordingly, the upper shell **12** is thinner in the regions **12x, 12y** and **12z** than in the regions **12x′**, **12y′** and **12z′**.

As shown in FIGS. **76** and **79,** the top of the first portion **122a** of the disc holder **22a** is located at a vertical level higher than the bottom of the disc stopper **53**. Also, the top of the first portion **122a** of the disc holder **22a** is received

by the recessed first region **12x** on the inner upper surface **12u**. Since the stepped protrusion **223** is formed at the top of the first portion **122a**, just a part of the upper surface of the first portion **122a** is in contact with the inner upper surface **12u**. On the other hand, the second portion **222a** of the disc holder **22a** is not in contact with the inner upper surface **12u**.

To open and close the shutters **21** and **22** smoothly, the friction caused by the contact between the top of the first portion **122a** of the disc holder **22a** and the inner upper surface **12u** is preferably small. For that purpose, the top of the first portion **122a** of the disc holder **22a** has an arc-shaped cross section when taken in the radial direction of the disc **100**. This stepped protrusion **223** is provided to compensate for shortage in mechanical strength, which would be caused by a sharpened top of the first portion **122a**, and to make that top moldable more accurately and more easily.

As shown in FIG. **80**, the top of the first portion **122b** of the disc holder **22b** is also located at a vertical level higher

than the bottom of the disc stopper **53**. And the top of the first portion **122b** of the disc holder **22b** is received by the recessed first region **12z** on the inner upper surface **12u**. Although not shown, the top of the first portion **121b** of the disc holder **21b** is also located at a vertical level higher than the bottom of the disc stopper **53**, and is received by the recessed first region **12y** on the inner upper surface **12u**.

As described above, in the disc cartridge **314** of the fourteenth preferred embodiment, the regions **12x**, **12y** and **12z** on the inner upper surface **12u** are recessed to receive portions of the disc holders **22a**, **21b** and **22b**, respectively. Thus, the thickness of the disc cartridge **314** can be reduced by the depth of those recessed regions **12x**, **12y** and **12z**.

Even if the disc cartridge **314** having such a structure is loaded into a disc drive either vertically or upside down, the disc **100** that is no longer chucked never fails to contact with the slope **122a'** of the first portion **122a** of the disc holder **22a** as shown in FIG. **79** as the shutters **21** and **22** are closed. Thereafter, the disc **100** will slide smoothly along the slope **122a'** to contact with the slope **222a'** of the second portion

222a of the disc holder **22a** (see FIG. **74**). At the same time, the disc **100** also contacts with the slope **221a'** of the second portion **221a** of the disc holder **21a**. In this manner, the disc holders **21a** and **22a** hold the disc **100** thereon cooperatively. The two other disc holders **21b** and **22b** also hold the disc **100** thereon through similar operations. Accordingly, although this disc cartridge **314** has a reduced thickness, the disc cartridge **314** can close the shutters **21** and **22** in any position and can hold the disc **100** thereon just as intended.

If this disc cartridge had its thickness just reduced without changing the shapes of the disc holders (or using the disc holders of the thirteenth preferred embodiments as they are), the regions **12x**, **12x'**, **12y**, **12y'**, **12z** and **12z'** on the inner upper surface **12u**, through which the disc holders **22a**, **21b** and **22a** pass, should all be recessed as can be seen from FIG. **78**. In that case, the upper shell **12** would have a reduced thickness over a rather wide area and such a disc cartridge would have a decreased mechanical strength. In contrast, the disc cartridge **314** of this fourteenth preferred embodiment can have its thickness reduced without decreasing

its mechanical strength because the regions **12x**, **12y** and **12z** with a reduced thickness are relatively narrow.

In the preferred embodiment described above, three protrusions are provided for three of the four disc holders. However, the number of protrusions to be provided is changeable with the number of disc holders or the shapes of the shutters.

The disc cartridge **314** of the fourteenth preferred embodiment is also different from the disc cartridge **313** of the thirteenth preferred embodiment in the shape of the disc stoppers **53**.

As shown in FIG. **72**, the disc stoppers **53** have the shape of a notched circular plate. Specifically, notches **54** having substantially the same shape as the disc stoppers **53** are provided along the disc window **12w** of the upper shell **12** and the disc stoppers **53** are engaged in a rotatable state with the notches **54**. As shown in FIG. **77**, the disc stoppers **53** are held in such a manner as to partially protrude into the disc window **12w** of the upper shell **12** when rotated. Also, as shown in FIG. **78**, by rotating the disc stoppers **53**, the disc

stoppers **53** may also be held in such a manner as to be stored inside the upper shell **12** and not to protrude into the disc window **12w**. If the disc stoppers **53** are easily disengaged from the notches **54** unintentionally, then the side surfaces of the disc stoppers **53** and the notches **54** of the upper shell **12** may have mutually engaging concave and convex portions, for example.

In such a structure, the thickness of the disc stoppers **53** may be substantially equal to that of the upper part of the upper shell **12**. Thus, the disc cartridge **314** can have a reduced overall thickness.

The disc cartridge **314** of this fourteenth preferred embodiment is also characterized by including a disc supporting portion **60** at the bottom of the inner periphery of the disc storage portion. The disc supporting portion **60** is located between the inner lower surface **11u** and the inner side surface **11i** of the cartridge body **10** as shown in FIGS. **72**, **77**, **78** and **81**. As shown in FIG. **81**, the disc supporting portion **60** has an upper surface **60a**, which is parallel to the inner lower surface **11u** of the cartridge body **10**.

As also shown in FIG. **81**, while the shutters **21** and **22** are closed and the disc **100** is held by the disc holders, the outer edge and its surrounding portion of the signal recording side **100A** of the disc **100** are in contact with the upper surface **60a** of the disc supporting portion **60**. Thus, no dust will be deposited on the signal recording side **100A** of the disc **100** or accumulated on the inner lower surface **11u** of the cartridge body **10**.

Alternatively, the disc supporting portion **60** may have any shape other than that shown in FIG. **81**. For example, as shown in FIG. **82**, a disc supporting portion **76** having an upwardly tapered cross section may be formed between the inner lower surface **11u** and the inner side surface **11i** of the cartridge body **10**. In that case, while the shutters **21** and **22** are closed and the disc **100** is held by the disc holders, the outer edge of the signal recording side **100A** of the disc **100** is in contact with the disc supporting portion **76**.

EMBODIMENT 15

Hereinafter, a disc cartridge **315** according to a

fifteenth specific preferred embodiment of the present invention will be described with reference to FIGS. **83** through **87**. In FIGS. **83** through **87**, each member of the disc cartridge **315** of the fifteenth preferred embodiment, having substantially the same function as the counterpart of the disc cartridge **314** of the fourteenth preferred embodiment described above, is identified by the same reference numeral.

As shown in FIG. **83**, unlike the disc cartridge **314** of the fourteenth preferred embodiment described above, the disc cartridge **315** of this fifteenth preferred embodiment includes four types of recesses **85**, **86**, **87** and **88a** through **88c**. The recesses **85** are formed on the respective lower surfaces **21v** and **22v** of the shutters **21** and **22**. The other three types of recesses **86**, **87** and **88a** through **88c** are formed on the inner lower surface **11u** of the cartridge body **10** that contacts with the shutters **21** and **22**. These four types of recesses will be described below one by one. Where the disc cartridge **315** is supposed to hold a disc having a diameter of about 12 cm, these recesses may have a depth of about 0.1 mm to about 0.3 mm, for example.

As can be seen from FIGS. **84** and **85** illustrating two states of the disc cartridge **315** in which its shutters **21** and **22** are closed and opened, respectively, the first type of recesses **86** are formed in respective regions of the inner lower surface **11u** that contact with the disc holders **21a, 21b, 22a** and **22b** of the shutters **21** and **22** when the shutters **21** and **22** are opened or closed.

The disc holders **21a, 21b, 22a** and **22b** are sandwiched between the upper and lower shells **12** and **11** with almost no gap left between them. Accordingly, when respective members of the disc cartridge **315** are assembled together or if any of those members of the disc cartridge **315** has a size that is greatly different from the designed one, the disc holders **21a, 21b, 22a** and **22b** might contact with the upper and lower shells **12** and **11**. In that case, excessive friction would be created between the disc holders **21a, 21b, 22a** and **22b** and the upper or lower shell **12** or **11**. As a result, the shutters **21** and **22** might be unable to be opened or closed so easily or dust might be stirred up due to the excessive friction.

However, by providing the first type of recesses **86**,

gaps are provided under the disc holders **21a, 21b, 22a** and **22b**, thus reducing such unwanted friction. Then, the shutters **21** and **22** can always be opened or closed smoothly and no dust will be stirred up due to the friction.

The second type of recesses **87** are formed in those regions of the inner lower surface **11u** where the respective outer edges of the shutters **21** and **22** are located while the shutters **21** and **22** are closed. As shown in FIGS. **84** and **86**, these recesses **87** preferably extend along the boundary that defines the outer edges of the shutters **21** and **22** on the inner lower surface **11u** and are preferably present both inside and outside of the boundary.

This disc cartridge **315** is supposed to store the disc **100** therein with one side thereof exposed, and the user can press the disc **100** in the direction indicated by the arrow **A** in FIG. **86**. To protect the signal recording side **100A** of the disc **100**, the respective upper surfaces of the shutters **21** and **22** are covered with the nonwoven fabrics **21s** and **22s** but their outer edges are not completely covered with the nonwoven fabrics **21s** and **22s**. Accordingly, if the disc **100** is pressed

in the direction **A**, then the outer edges of the shutters **21** and **22** contact with the signal recording side **100A** of the disc **100**, thus possibly scratching the signal recording side **100A** as shown in FIG. **86**.

However, if the second type of recesses **87** are provided, the shutters **21** and **22** may be deformed in such a manner that the outer edges thereof are partially forced into the second type of recesses **87**. Then, the pressing force can be dispersed, and the outer edges of the shutters **21** and **22** will not be pressed against the signal recording side **100A** of the disc **100** too strongly.

The third type of recesses include: recesses **88a** that are formed on the inner lower surface **11u** so as to surround the chucking and head openings **11c** and **11h**; recesses **88b** that are formed in those regions of the inner lower surface **11u** that are not overlapped by the shutters **21** and **22** when the shutters **21** and **22** are closed; and a recess **88c** that is located in a region of the inner lower surface **11u** that is overlapped by the shutters **21** and **22** when the shutters **21** and **22** are closed. The recesses **88b** and **88c** are provided so as to draw a circle

along the circumference of the disc storage portion **10d**. In this preferred embodiment, the number of the recesses **88a** of the third type is three.

This disc cartridge **315** is also provided with various types of structures (e.g., a disc supporting portion) for preventing dust from entering the disc cartridge **315** or being deposited on the signal recording side **100A** of the disc **100**. However, it is actually difficult to totally eliminate the dust that enters the disc cartridge **315** or is deposited on the signal recording side **100A**.

Thus, the third type of recesses **88a, 88b** and **88c** are provided to accumulate the dust that has entered the disc cartridge **315**. Specifically, as the shutters **21** and **22** are opened or closed, the dust is collected in these recesses **88a, 88b** and **88c** of the third type. Once collected in the recesses **88a, 88b** and **88c**, the dust never contacts with the shutters **21** and **22** and remains in the recesses **88a, 88b** and **88c** without going out of the recesses **88a, 88b** and **88c**. Accordingly, by accumulating the dust in the third type of recesses **88a, 88b** and **88c** in this manner, the dust will not interfere with

opening or closing of the shutters **21** and **22** or will be stirred up due to an excessive friction.

It should be noted that these effects are also achievable by the first type of recesses **86** or the second type of recesses **87**. Accordingly, the disc cartridge **315** does not have to include all of these recesses **86, 87, 88a, 88b** and **88c** but may include just one type of recesses. Even so, the shutters **21** and **22** will not be interfered with their opening or closing by the dust and almost no dust will be stirred up due to a friction.

Also, to remove the dust from the gap between the shutters **21** and **22** and the inner lower surface **11u** and accumulate it in the second type of recesses **87**, for example, even more effectively, the respective lower surfaces **21v** and **22v** of the shutters **21** and **22** may be provided with the recesses **85** along the outer edges thereof. In that case, when the shutters **21** and **22** are closed, these recesses **85** are preferably located inside the second type of recesses **87** (i.e., closer to the centerline of the cartridge **315**) as shown in FIG. **84**. Also, as shown in FIG. **86**, when the shutters **21** and **22**

are closed, the recesses **85** of the shutters **21** and **22** are preferably discontinuous with the second type of recesses **87** on the inner lower surface **11u**.

When the shutters **21** and **22** have the recesses **85**, the outer edges of the shutters **21** and **22** are deformed more easily. Accordingly, even when a force is externally applied to the disc **100** in the direction **A**, the outer edges of the shutters **21** and **22** are deformed easily and will much less likely press the signal recording side **100A** of the disc **100** so strongly as to scratch it. Optionally, these recesses **86**, **87**, **88a**, **88b** and **88c** may have their inner faces covered with a nonwoven fabric that has been adhered or welded thereto. Then, the gaps created by these recesses inside the cartridge body can be filled and dust will enter this disc cartridge **315** even less easily.

In the fifteenth preferred embodiment described above, the various types of recesses are provided for the disc cartridge **314** of the fourteenth preferred embodiment. Alternatively, these recesses may also be provided for the disc cartridge according to any of the eighth through

thirteenth preferred embodiments of the present invention described above.

EMBODIMENT 16

Hereinafter, a disc cartridge **316** according to a sixteenth specific preferred embodiment of the present invention will be described with reference to FIGS. **88** through **93**. In FIGS. **88** through **93**, each member of the disc cartridge **316** of the sixteenth preferred embodiment, having substantially the same function as the counterpart of the disc cartridge **313** of the thirteenth preferred embodiment described above, is identified by the same reference numeral.

As shown in FIG. **88**, the disc cartridge **316** of this preferred embodiment includes first and second opener/closers **22t** and **93** on first and second side surfaces **10p** and **10q** of the cartridge body **10**, respectively. The first opener/closer **22t** is formed on the first side surface **10p** that extends substantially vertically to the direction **1A** in which this disc cartridge **316** is inserted into a disc drive, while the second opener/closer **93** is formed on the second side surface

10q that extends substantially parallelly to the direction **1A**. The first opener/closer **22t** has the same structure as the shutter opener/closer **22t** of the disc cartridge **313** of the thirteenth preferred embodiment.

As shown in FIG. **89**, the second opener/closer **93** is formed in the shape of a gear having a hole that can be inserted into a shaft **11q** provided for the lower shell **11**. A side surface of the lower shell **11** has an opening **11r** to expose a portion of the second opener/closer **93** through the second side surface **10q** of the cartridge body **10** when the second opener/closer **93** is inserted into the shaft **11q**. Alternatively, the shaft **11q** may be provided for the upper shell **12**.

The shutters **21** and **22** are also provided to expose or cover the head and chucking openings **11h** and **11c** of the lower shell **11**. The shutters **21** and **22** are equivalent to the second and first shutters as defined in the appended claims. The first opener/closer **22t** forms an integral part of the shutter **22**. On the other hand, a sector gear **21m**, which engages with the second opener/closer **93**, is formed on the outer side

surface of the shutter **21** and is located near the disc holder **21b**. The center of rotation of the sector gear **21m** is the hole **21u** of the shutter **21**. The outer side surface of the shutter **21** also has a concave portion **21n**, which is adjacent to the sector gear **21m**. This concave portion **21n** is formed to define a space in which the second opener/closer **93** engages with the sector gear **21m**.

The shutters **21** and **22** may be opened or closed by using the first opener/closer **22t** in the following manner. First, as shown in FIG. **90**, the locking protrusion **21k** and the locking engaging portion **22k**, which together make up the locking mechanism **20k**, are disengaged from each other. Then, the first opener/closer **22t** is slid along the first side surface **10p** of the cartridge body **10** as indicated by the arrow **22W** in FIG. **90**. As a result, the other shutter **21** is also moved synchronously with the shutter **22** by way of the interlocking mechanism **20c**, and these two shutters **21** and **22** expose the head and chucking openings **11h** and **11c** as shown in FIG. **91**.

The shutters **21** and **22** may also be opened by using the

second opener/closer **93** in the following manner. First, the locking mechanism **20k** is unlocked as shown in FIG. **90**. Next, the second opener/closer **93** is rotated to the direction indicated by the arrow **93A**. Then, the sector gear **21m** gets engaged with the second opener/closer **93** and starts to rotate on the hole **21u**, thereby opening the shutter **21**. Since the other shutter **22** is also moved synchronously with the shutter **21** by way of the interlocking mechanism **20c**, these two shutters **21** and **22** expose the head and chucking openings **11h** and **11c**. When the head and chucking openings **11h** and **11c** are completely exposed by the shutters **21** and **22** as shown in FIG. **91**, a portion of the second opener/closer **93** is located inside the concave portion **21n** of the shutter **21**.

To close the shutters **21** and **22**, the first opener/closer **22t** may be slid in the direction opposite to the direction **22W** or the second opener/closer **93** may be rotated to the direction opposite to the direction **93A**. In this preferred embodiment, the disc cartridge **316** includes the shutter springs **31** and **32** that apply an elastic force to the shutters **21** and **22** in such a direction as to close the shutters **21** and **22**. Accordingly,

unless a force that is strong enough to open, or keep opened, the shutters **21** and **22** against the elastic force of the shutter springs **31** and **32** is applied to the first or second opener/closer **22t** or **93**, the shutters **21** and **22** close themselves automatically.

In the disc cartridge **316** of the sixteenth preferred embodiment, the opener/closers are provided for the shutters **21** and **22** both on a side surface that is perpendicular to the direction in which this disc cartridge **316** is inserted into a disc drive and on a side surface that is parallel to the disc cartridge inserting direction. Accordingly, no matter whether the disc drive used is compatible with only a disc cartridge including a shutter opener/closer on a side surface that extends perpendicularly to the disc cartridge inserting direction or only a disc cartridge including a shutter opener/closer on a side surface that extends parallelly to the disc cartridge inserting direction, the disc drive can always read or write a signal from/on the disc stored in the disc cartridge of this preferred embodiment.

Also, in the disc cartridge **316** of this sixteenth

preferred embodiment, the second opener/closer **93**, provided for the side surface parallel to the direction in which the disc cartridge **316** is inserted, has a gear shape. Accordingly, a shutter opening/closing mechanism to be provided for the disc drive may also be any of various shapes of gears that can engage with the second opener/closer **93**. Thus, the disc drive may use a relatively simple mechanism to open or close the shutters **21** and **22** of the disc cartridge **316**.

In the preferred embodiment described above, the sector gear **21m** is provided near the disc holder **21b**. This is because the distance between the sector gear **21m** at such a position and the hole **21u** of the shutter **21** is relatively short and because the sector gear **21m** needs to have a relatively short length to open the shutter **21** fully. However, the sector gear **21m** does not have to be provided at this position. Alternatively, the sector gear **21m** and the second opener/closer **93** may also be provided at such positions as shown in FIGS. **92** and **93**. In the alternative preferred embodiment shown in FIGS. **92** and **93**, the sector gear **21m** may be located at such a position that when extended, a circular

trace drawn by the sector gear **21m** will substantially intersect with the center of the disc **100**, while the second opener/closer **93** may be provided at such a position as to engage with the sector gear **21m**. When the second opener/closer **93** is provided at such a position, the sector gear **21m** should be relatively long to open the shutter **21** fully, but the distance between the sector gear **21m** and the hole **21u** may also be relatively long. That is to say, since there is a long distance between the fulcrum and the application point in that case, a lighter force is needed to rotate the second opener/closer **93** and open or close the shutters **21** and **22**.

EMBODIMENT 17

Hereinafter, a disc cartridge **317** according to a seventeenth specific preferred embodiment of the present invention will be described with reference to FIGS. **94** through **97**. In FIGS. **94** through **97**, each member of the disc cartridge **317** of the seventeenth preferred embodiment, having substantially the same function as the counterpart of the

disc cartridge **316** of the sixteenth preferred embodiment described above, is identified by the same reference numeral.

As shown in FIG. **94,** the disc cartridge **317** of this seventeenth preferred embodiment includes a second opener/closer **94** on its second side surface **10q** instead of the second opener/closer **93** of the disc cartridge **316** of the sixteenth preferred embodiment described above.

As can be seen from FIG. **95,** the second opener/closer **94** is a link member that can slide along the opening **11r** of the lower shell **11** and that is bent approximately at the center thereof. Also, the second opener/closer **94** includes a protrusion **94a** at one end thereof. This protrusion **94a** engages with a groove **21i** that is provided on the upper surface of the shutter **21** near the disc holder **21b.**

FIGS. **96** and **97** illustrate two states of the disc cartridge **317** in which the shutters **21** and **22** thereof are closed and opened, respectively. As already described for the thirteenth and sixteenth preferred embodiments, the shutters **21** and **22** can be opened or closed by sliding the first opener/closer **22t** in the direction **22w** or in the opposite

direction.

The shutters **21** and **22** may also be opened by using the second opener/closer **94** in the following manner. First, the locking mechanism **20k** is unlocked as shown in FIG. **96**. Next, the second opener/closer **94** is slid in the direction indicated by the arrow **94B**. As a result of this operation, a force is applied to the second opener/closer **94** in such a direction as to move the protrusion **94a** of the second opener/closer **94** in the direction indicated by the arrow **94B**. Thus, the shutter **21** is rotated on the hole **21u** and opened. Since the other shutter **22** is also moved synchronously with the shutter **21** by way of the interlocking mechanism **20c**, these two shutters **21** and **22** expose the head and chucking openings **11h** and **11c**. As in the sixteenth preferred embodiment described above, the shutters **21** and **22** can also be closed by sliding the second opener/closer **94** in the direction opposite to the direction **94B**, and the shutter springs **31** and **32** also apply an elastic force to the shutters **21** and **22** in such a direction as to close the shutters **21** and **22**.

Just like the disc cartridge **316** of the sixteenth

preferred embodiment described above, no matter whether the disc drive used is compatible with only a disc cartridge including a shutter opener/closer on a side surface that extends perpendicularly to the disc cartridge inserting direction or only a disc cartridge including a shutter opener/closer on a side surface that extends parallelly to the disc cartridge inserting direction, the disc drive can always read or write a signal from/on the disc stored in the disc cartridge **317** of this preferred embodiment.

Also, as shown in FIGS. **96** and **97**, the direction **94B** in which the second opener/closer **94** is slid to open the shutters **21** and **22** is antiparallel to the disc cartridge inserting direction **1A**. Accordingly, if a protrusion that engages with the second opener/closer **94** is provided for a disc drive, that protrusion engages with the second opener/closer **94** and opens the shutters **21** and **22** of the disc cartridge **317** while this disc cartridge **317** is going to be inserted into the disc drive. Thus, a simplified shutter opening/closing mechanism may be provided for the disc drive.

EMBODIMENT 18

Hereinafter, a disc cartridge **318** according to an eighteenth specific preferred embodiment of the present invention will be described with reference to FIGS. **98** through **101**. In FIGS. **98** through **101**, each member of the disc cartridge **318** of the eighteenth preferred embodiment, having substantially the same function as the counterpart of the disc cartridge **316** of the sixteenth preferred embodiment described above, is identified by the same reference numeral.

As shown in FIG. **98**, the disc cartridge **318** of this eighteenth preferred embodiment includes a second opener/closer **96** on its second side surface **10q** instead of the second opener/closer **93** of the disc cartridge **316** of the sixteenth preferred embodiment described above.

As can be seen from FIG. **99**, the second opener/closer **96** is a belt member that is connected to the disc holder **21a** of the shutter **21**. This belt member **96** has a protrusion **96a** at one end thereof. And the protrusion **96a** can slide along the opening **11r** of the lower shell **11**. Alternatively, the second opener/closer **96** may form an integral part of the shutter **21**.

FIGS. **100** and **101** illustrate two states of the disc cartridge **318** in which the shutters **21** and **22** thereof are closed and opened, respectively. As already described for the sixteenth and seventeenth preferred embodiments, the shutters **21** and **22** can be opened or closed by sliding the first opener/closer **22t** in the direction **22w** or in the opposite direction.

The shutters **21** and **22** may also be opened by using the second opener/closer **96** in the following manner. First, the locking mechanism **20k** is unlocked as shown in FIG. **100**. Next, the protrusion **96a** of the second opener/closer **96** is slid in the direction indicated by the arrow **96B**. As a result of this operation, a force is applied to the shutter **21** in such a direction as to rotate the end of the shutter **21** on the hole **21u**, i.e., to the direction indicated by the arrow **96C**. Since the other shutter **22** is also moved synchronously with the shutter **21** by way of the interlocking mechanism **20c**, these two shutters **21** and **22** expose the head and chucking openings **11h** and **11c**. To close the shutters **21** and **22**, the protrusion **96a** of the second opener/closer **96** may be slid in the opposite

direction.

Just like the disc cartridge **316** of the sixteenth preferred embodiment described above, no matter whether the disc drive used is compatible with only a disc cartridge including a shutter opener/closer on a side surface that extends perpendicularly to the disc cartridge inserting direction or only a disc cartridge including a shutter opener/closer on a side surface that extends parallelly to the disc cartridge inserting direction, the disc drive can always read or write a signal from/on the disc stored in the disc cartridge **318** of this preferred embodiment.

If the second opener/closer **96** forms an integral part of the shutter **21**, the number of members that make up the disc cartridge **318** can be reduced. As a result, the disc cartridge can be manufactured at a lower cost or the manufacturing process thereof can be simplified.

In the sixteenth through eighteenth preferred embodiments of the present invention described above, the second opener/closer is provided on the left-hand side with respect to the disc cartridge inserting direction. However, the

location of the second opener/closer is not limited to the left-hand side. Alternatively, the second opener/closer may be provided on the right-hand side **10r** of the disc cartridge **316** with respect to the disc cartridge inserting direction as shown in FIG. **88**. As another alternative, the second opener/closer may also be provided on the backside **10t** of the disc cartridge **316** as shown in FIG. **88**. In that case, the belt-shaped second opener/closer **96** of this eighteenth preferred embodiment is preferably used because the disc cartridge **318** can have the protrusion **96a** of the second opener/closer **96** on its backside without changing its details so much.

EMBODIMENT 19

Hereinafter, a disc cartridge **319** according to a nineteenth specific preferred embodiment of the present invention will be described with reference to FIGS. **102** and **103**. In FIGS. **102** through **103**, each member of the disc cartridge **319** of the nineteenth preferred embodiment, having substantially the same function as the counterpart of the

disc cartridge **313** of the thirteenth preferred embodiment described above, is identified by the same reference numeral.

The disc cartridge **319** of this preferred embodiment is characterized by providing rotation stoppers **97** for the disc holders **21b**, **22a** and **22b** and concave portions **89** for the shutters **21** and **22**, respectively. The concave portions **89** are used to ultrasonic weld a nonwoven fabric to the shutters **21** and **22**.

More specifically, the disc holders **21b**, **22a** and **22b** include holes **21q**, **22r** and **22q** that engage with the rotation stoppers **97**. As shown in FIG. **103**, the rotation stoppers **97** partially protrude from the slopes **21b'**, **22a'** and **22b'** of the disc holders **21b**, **22a** and **22b** and contact with the outer edge of the disc **100** while the disc **100** is held by the disc holders **21a**, **21b**, **22a** and **22b**. The rotation stoppers **97** are preferably made of an elastic material that has a large coefficient of friction, e.g., rubber.

It should be noted that at least one of the disc holders **21a**, **21b**, **22a** and **22b** should include the rotation stopper **97** to stop the unwanted rotation of the disc **100** sufficiently.

However, to prevent the unintentional rotation of the disc **100** with more certainty, the three rotation stoppers **97** are preferably provided as shown in FIG. **102**.

In this structure, while the disc **100** is held by the disc holders **21a**, **21b**, **22a** and **22b**, the rotation stoppers **97** that are in tight contact with the disc **100** do not allow the user to rotate the disc **100** so easily. Accordingly, in such a state, even if the user tries to rotate the disc **100** intentionally while pressing the disc **100** against the shutters **21** and **22**, the disc **100** will not rotate so easily. Thus, even if relatively stiff dust has adhered to the nonwoven fabric that covers the shutters **21** and **22**, the disc **100** will not get scratched by such dust because the user cannot rotate the disc **100** accidentally.

In addition, by providing the rotation stoppers **97**, it is possible to prevent the disc **100** from moving inconstantly inside the disc storage portion.

As shown in FIG. **102**, the shutters **21** and **22** include the concave portions **89** to which a nonwoven fabric is ultrasonic welded to partially cover the shutter surfaces that contact

with the signal recording side **100A** of the disc **100**. In the preferred embodiment illustrated in FIG. **102**, the concave portions **89** are formed so as to surround the outer periphery of those portions of the shutters **21** and **22** that contact with the signal recording side **100A**. The concave portions **89** are also formed inside the outer periphery. However, the concave portions **89** may be formed in any regions other than those illustrated in FIG. **102** as long as the nonwoven fabric can be adhered to the shutters **21** and **22** just as intended. At these concave portions **89**, the nonwoven fabric is ultrasonic welded to the shutters **21** and **22**. When the nonwoven fabric is ultrasonic welded to the shutters **21** and **22**, the nonwoven fabric might be partially cured or the resin material of the shutters **21** and **22** might partially protrude from the nonwoven fabric. Even so, those cured or protruding portions are received by the concave portions **89** and do not scratch the signal recording side **100A** of the disc **100**. When a nonwoven fabric is attached to the shutters **21** and **22**, these concave portions **89** are preferably formed on the shutters **21** and **22** in any of the disc cartridges according to the first through

eighteenth preferred embodiments of the present invention described above.

EMBODIMENT 20

Hereinafter, a disc cartridge **320** according to a twentieth specific preferred embodiment of the present invention will be described with reference to the accompanying drawings.

First, the overall structure of the disc cartridge **320** will be outlined with reference to FIG. **104.** The disc cartridge **320** includes lower shell **11**, upper shell **12**, first shutter **21**, second shutter **22**, disc stopper **23**, shielding member **24** and rotational member **25.** These members may be made of a synthetic resin, for example. However, there is no need to make all of these members of the same material. Instead, best materials may be selected for these members in view of the mechanical strengths or appearance required for them.

As shown in FIG. **104**, the cartridge body **10** has an inner lower surface **11u**. The inner lower surface **11u** has a chucking opening **11c** and a head opening **11h**. The chucking opening **11c**

allows a chucking member (e.g., a spindle motor for rotating the disc **100**) to enter the disc cartridge **320** externally. The head opening **11h** allows a head, which reads and/or writes a signal (or information) from/on the signal recording side **100A** of the disc **100**, to enter the disc cartridge **320** and access a target location on the disc **100**. The head opening **11h** is continuous with the chucking opening **11c** and reaches one side surface of the lower shell **11**. Also, another opening **11r** is provided on another side surface of the lower shell **11**, which is adjacent to the side surface having the head opening **11h**. The lower shell **11** further includes a pair of positioning holes **11w** to engage with a pair of cartridge positioning pins of the disc drive and thereby position the disc cartridge **320** with respect to the disc drive.

As will be described in detail later, the inner lower surface **11u** has two grooves **11e** and **11f** that receive the respective ends of convex portions **25e** and **25f** provided for the rotational member **25**. These grooves **11e** and **11f** preferably do not reach the bottom of the inner lower surface **11u**. The inner lower surface **11u** further includes holes **39** that receive

shafts **37** and **38** provided for the first and second shutters **21** and **22**, respectively. These holes **39** preferably do not reach the bottom of the inner lower surface **11u**, either. In the preferred embodiment illustrated in FIG. **104**, the shafts **37** and **38** are formed on the first and second shutters **21** and **22** and the holes **39** are formed on the lower shell **11**. Alternatively, holes may be formed on the first and second shutters **21** and **22** and shafts may be formed on the lower shell **11**.

A type recognizing region **11a** for use to recognize the type of the disc **100** in the disc cartridge **320** is provided near one of the positioning holes **11w** of the lower shell **11**. The types of the disc **100** are made correspond to the states of the type recognizing region **11a**. That is to say, if one type of disc **100** is stored in the disc cartridge **320**, the type recognizing region **11a** of the disc cartridge **320** may have a concave portion. However, if another type of disc **100** is stored in the disc cartridge **320**, the type recognizing region **11a** may have no concave portion. The concave portion may define either an opening or a recess. Alternatively, the type

recognizing region **11a** of the lower shell **11** may define an opening, but at least a portion of the opening is preferably covered with a cap member such that no concave portion is normally present there. In that structure, the concave portion may be present by removing the cap member.

The disc drive, to which the disc cartridge **320** is loaded, determines whether or not the concave portion is present in the type recognizing region **11a**. Based on the result, the disc drive selects a specific mode of control to perform. Accordingly, the difference in type between the discs **100** stored is preferably a difference in structure between the discs **100**, which would require the disc drive to perform mutually different types of controls on them. For example, the type recognizing region **11a** may be used to determine whether the disc **100** stored has a single recording side or double recording sides (i.e., whether the disc **100** has a single recording layer structure or a double recording layer structure). More specifically, if the disc **100** has a double recording layer structure, then the type recognizing region **11a** may define a concave portion. On the other hand, if the

disc **100** has a single recording layer structure, then the type recognizing region **11a** may define no concave portion. Alternatively, the type recognizing region **11a** may define a concave portion when the disc **100** stored has a single recording layer structure and may define no concave portion when the disc **100** stored has a double recording layer structure.

To be compatible with both a single-sided disc and a double-sided disc, the disc drive to be loaded with the disc cartridge **320** should switch the output powers of its recording laser beam depending on the specific recording layer structure of the disc that has been inserted thereto. The reason is as follows. Specifically, if the disc drive attempts to write information on a single-sided disc with the output power of its recording laser beam misadjusted to a double-sided disc, then the recording area of the single-sided disc will be exposed to excessively high-power laser beam and the data stored there may be destroyed.

For that reason, when a disc cartridge including a disc is loaded into such a disc drive, the read/write head of the

disc drive normally emits a laser beam toward the disc in the disc cartridge and detects the light that has been reflected from the disc, thereby determining whether the disc in the disc cartridge is single-sided or double-sided. This operation of the disc drive is a sort of learning.

However, if the disc drive has failed to recognize the type of the inserted disc correctly for some reason, then the information stored on the disc might be destroyed by mistake.

Accordingly, if the presence and absence of that concave portion in/from the type recognizing region **11a** of the disc cartridge **320** respectively represent the two possible types of the disc **100** in the disc cartridge **320**, then the disc drive can correctly recognize the specific type of the disc **100** inserted thereto by checking out the type recognizing region **11a**. Thus, the information stored on the disc is not destroyed by mistake.

Also, the "learning" operation described above normally takes several seconds to about ten seconds, and may take an even longer time if the disc drive irradiates and detects the laser beam repeatedly to recognize the disc type more

accurately. However, if the disc cartridge **320** includes the type recognizing region **11a** that may or may not have the concave portion depending on the specific structure of the disc **100** stored therein so as to allow the disc drive to recognize the type of the disc **100** easily by checking out the type recognizing region **11a**, then the learning operation may be omitted or shortened significantly at least. Thus, the disc drive can get ready to read and/or write information from/onto the disc **100** in just a short time after the disc cartridge **320** including the disc **100** has been loaded into the disc drive.

Although the disc cartridge **320** shown in FIG. **104** has a structure that allows the user to remove the disc **100** from the disc cartridge **320**, the disc cartridge **320** including the type recognizing region **11a** preferably has a structure that prohibits the user from removing the disc **100** from the disc cartridge **320**. This is because if the user can remove the disc **100** from the disc cartridge **320** easily, then the user may store another type of disc **100** in the disc cartridge **320** to nullify the presence or absence of the concave portion in/from

the type recognizing region **11a**. Alternatively, the disc cartridge **320** may also have a structure that allows the user to remove the disc **100** therefrom. In that case, however, some means should be provided to indicate the user's removal of the disc **100** from the disc cartridge **320**. If that means indicates that the disc **100** has been removed from the disc cartridge **320**, then the information represented by the type recognizing region **11a** may be incorrect. Thus, that information should not be relied on in that case.

Next, the specific structure of the upper shell **12** will be described. The upper shell **12** includes a circular disc window **12w**, which expands over the entire projection area of the disc **100**. The disc window **12w** is defined by a cylindrical inner side surface **12i** of the cartridge body **10**. The disc **100** can be inserted into the disc cartridge **320** through this disc window **12w**. The inner side surface **12i** has a notch **12g**.

The upper surface **12d** of the upper shell **12** also has a notch **12j**, which engages with the disc stopper **23**. Although not shown, the disc stopper **23** and the upper surface **12d** of

the upper shell **12** are provided with concavo/convex portions, which engage with each other so that the disc stopper **23** does not disengage itself from the upper shell **12** easily. When the disc stopper **23** is fitted with the upper shell **12**, a portion of the disc stopper **23** protrudes into the disc window **12w**. In this preferred embodiment, to reduce the overall thickness of the cartridge body as much as possible, the notch **12j** is formed by removing a portion of the upper shell **12** completely. However, if the disc cartridge may have a thickness somewhat greater than that of the illustrated one, a concave portion may also be formed instead of the notch **12j** by removing a portion of the upper shell **12** incompletely, and a disc stopper engaging with such a concave portion may be prepared. For example, the notch and the disc stopper **23** of the disc cartridge **308** of the eighth preferred embodiment described above may be provided for the disc cartridge **320** of this twentieth preferred embodiment.

Another disc stopper **12s** is provided as an integral part of the upper surface **12d** of the upper shell **12** so as to protrude into the disc window **12w**. The disc stoppers **12s** and

23 are arranged symmetrically to each other with respect to the center of the circular opening that is defined by the disc window **12w**. The disc stoppers **12s** and **23** are used to prevent the disc **100** from dropping down through the disc window **12w.** These disc stoppers **12s** and **23** are particularly effective when this disc cartridge **320** is loaded into a vertically mounted disc drive. To remove the disc **100** from this disc cartridge **320**, the disc stopper **23** needs to be disengaged and removed from the upper shell **12**, and the disc **100** needs to be picked up from around the notch **12j**, for example. Optionally, three or more disc stoppers may be provided and/or each of the disc stoppers may be formed in any other shape or disposed at any position other than that illustrated in FIG. **104.**

FIG. **119** is a plan view of the disc cartridge **320.** As is clear from FIG. **119**, the closer to the center **C1** of the disc window **12w** the disc stoppers **12s** and **23** reach, the less likely the disc **100** drops through the disc window **12w.** However, as the disc stoppers **12s** and **23** reach closer toward the center **C1**, the area of overlap between each disc stopper **12s** or **23** and the disc **100** increases as indicated by the hatching in FIG.

119.

The greater the overlap area, the more easily an unexpected object is caught in the gap between the protruding disc stopper **12s** or **23** and the disc **100**. Some unexpected object that has entered the gap between the disc stopper **12s** or **23** and the disc **100** might be undetectable because the unexpected object might hide itself behind the disc stopper **12s** or **23**. The probability of intrusion of big unexpected objects and the inability to detect those unexpected objects both increase with the expansion of the area of overlap between the disc stopper **12s** or **23** and the disc **100**.

If the disc cartridge **320** with such an unexpected object caught in the gap between the disc stopper **12s** or **23** and the disc **100** is inserted into the disc drive, then the disc **100** could not be rotated normally by the disc drive or might get scratched or partially damaged. The disc drive might also cause a failure if such an unexpected object dropped inside the disc drive.

Furthermore, if the disc stoppers **12s** and **23** protrude excessively inward, then the disc **100** to be picked up from the

disc cartridge **320** by removing the disc stopper **23** from the upper shell **12** might come into contact with the inner edge of the disc stopper **12s** and could not be removed easily.

To overcome these problems, the radius **R1** of the disc **100** and the radius **R2** of a smallest circular opening **12w'**, of which the center matches with the center **C1** of the disc window **12w** and which is in contact with at least one of the disc stoppers **12s** and **23**, preferably satisfy the inequality of $14/15 \leqq R2/R1$. Also, to prevent the disc **100** from dropping through the disc window **12w**, the radii **R1** and **R2** preferably satisfy $R2/R1<1$, too. When the radii **R1** and **R2** satisfy these inequalities, the disc **100** will not drop through the disc window **12w** and yet the area of overlap between the disc stopper **12s** or **23** and the disc **100** can be too narrow to admit those unexpected objects. Thus, even if any unexpected object happens to be caught in the gap between the disc stopper **12s** or **23** and the disc **100**, that objects should be easily detectable. Also, the disc **100** to be picked up can be removed from the disc cartridge **320** just as intended. Furthermore, even if an increased number of disc stoppers are provided for

the disc cartridge **320** or if any of the disc stoppers extends a longer distance around the disc window **12w**, the first side (i.e., the label side) **100B** of the disc **100** can still be exposed almost entirely inside the circular opening **12w'**. Thus, the disc cartridge **320** looks great or beautiful by making use of the design on the label side of the disc **100**.

For example, if the disc **100** has a radius **R1** of about 60 mm (i.e., a diameter of about 120 mm), then the radius **R2** of the circular opening **12w'** is preferably about 56 mm. In that case, the overlap area between the disc stopper **12s** or **23** and the disc **100** has a width of about 4 mm in the disc radial direction. Accordingly, even if a clip, for example, has been caught as an unexpected object in the gap between the disc stopper **12s** or **23** and the disc **100**, the clip cannot hide itself behind the overlap area entirely but should protrude toward the circular opening **12w'** partially. Thus, the user can easily sense the existence of the clip in the gap between the disc stopper **12s** or **23** and the disc **100**. As a result, no damage will be done on the disc **100** or the disc drive.

As already described above, each of the disc stoppers **12s**

and **23** may have any other shape and be provided at any other position. Thus, a disc stopper having a different shape may be provided at a non-illustrated position. In any case, however, the alternative disc stopper also needs to protrude into the disc window **12w** and define the circular opening **12w'** inside it.

It should be noted that if there is no need to remove the disc **100** from the disc cartridge **320**, then the disc stopper may be a ring that surrounds the disc window **12w** fully with the circular opening **12w'** defined inside it.

The upper and lower shells **12** and **11** are adhered, welded or joined (e.g., screwed up) together around their outer periphery, thereby forming a cartridge body **10**. Also, the inner lower surface **11u** and the inner side surface **12i** of the cartridge body **10** together make up a disc storage portion for storing the disc **100** therein.

In the disc storage portion, the space defined by the inner side surface **12i** is wide enough to allow the disc **100** to rotate freely therein without contacting with the inner side surface **12i**. The top of the disc storage portion is opened as

the disc window **12w**, and the first side **100B** of the disc **100** stored in the disc storage portion is exposed entirely inside the disc window **12w**. On the other hand, the second side, i.e., the signal recording side **100A**, of the disc **100** faces the inner lower surface **11u**.

By adopting such a structure, the cartridge **320** can be thinner than the conventional cartridge in which both sides of the disc are covered. In addition, the label side of the disc **100** can be displayed inside the disc window **12w** and the user can check the contents of the disc **100** that were printed on the label side (i.e., the first side) **100B**. Moreover, by displaying the design of the label side, the disc cartridge including the disc can also have a good design.

The first and second shutters **21** and **22** are provided on the inner lower surface **11u** of the cartridge body **10**. When the disc **100** is stored inside the disc cartridge **320**, the first and second shutters **21** and **22** are located between the signal recording side (i.e., the second side) **100A** of the disc **100** and the inner lower surface **11u**. The first and second shutters **21** and **22** have the shafts **37** and **38**, respectively,

which are inserted into the holes **39** of the lower shell **11**. Thus, the first and second shutters **21** and **22** rotate on the shafts **37** and **38**, thereby covering or exposing the head and chucking openings **11h** and **11c**. When the first and second shutters **21** and **22** are opened, the second side **100A** of the disc **100** is partially exposed inside the head opening **11h**.

The first and second shutters **21** and **22** are provided with notches so as to define a hole **20h** in a region that overlaps with the center hole **100h** of the disc **100** stored in the disc storage portion when the first and second shutters **21** and **22** are closed. The notches of the first and second shutters **21** and **22** are surrounded with convex portions **21w** and **22w**, respectively. When the first and second shutters **21** and **22** are closed, these convex portions **21w** and **22w** are in close contact with each other, thereby forming a ring **20w** that is adjacent to the inner circumference of the center hole **100h** of the disc **100**. As already described in detail for the twelfth preferred embodiment, the ring **20w** prevents the dust from reaching the signal recording side **100A** of the disc **100** by way of the center hole **100h**. Furthermore, the convex portions **21w**

and **22w** have protrusions **35** and **36**, respectively. That is to say, the top of the protrusions **35** and **36** is higher than that of the convex portions **21w** and **22w**.

Furthermore, to hold the disc **100** in the disc storage portion while the first and second shutters **21** and **22** are closed, the first shutter **21** includes a disc holder **21b** and the second shutter **22** includes disc holders **22a** and **22b**. These disc holders **21b**, **22a** and **22b** work just like the disc holders as described for the eighth through nineteenth preferred embodiments described above. In the eighth through nineteenth preferred embodiments, the first shutter **21** further includes the disc holder **21a**. In this twentieth preferred embodiment, however, the first shutter **21** includes a convex portion **27a** instead of the disc holder **21a**. The convex portion **27a** is provided to prevent the side surface of the disc **100** from being exposed through the head opening **11h**, which reaches one side surface of the lower shell **11**, while the first and second shutters **21** and **22** are closed.

When closed, the first and second shutters **21** and **22** are not entirely in contact with each other along a line but have

a plurality of contact portions that are not aligned with the line. More specifically, the shutters **21** and **22** have a first pair of contact portions **21f** and **22f** and a second pair of contact portions **21g** and **22g**. In this preferred embodiment, the contact portions **21f** and **22f** contact with each other approximately along the centerline of the disc cartridge **320**. On the other hand, the contact portions **21g** and **22g** contact with each other along a line that defines a predetermined angle (e.g., approximately 15 degrees to approximately 18 degrees) with the centerline of the disc cartridge **320**. The effects achieved by such a structure are already described in detail for the thirteenth preferred embodiment. As also described for the thirteenth preferred embodiment, the contact portions **21g** and **22g** partially overlap with each other in the thickness direction of the disc **100**.

As will be described in detail later, the first and second shutters **21** and **22** include guide grooves **27e** and **28f** that respectively engage with the convex portions **25e** and **25f** of the rotational member **25**. The guide grooves **27e** and **28f** extend vertically through the first and second shutters **21** and

22, respectively, so that the convex portions **25e** and **25f** of the rotational member **25** can reach the grooves **11e** and **11f**, respectively.

The rotational member **25** includes a sidewall **25i** and a disc supporting portion **25a** that is connected to the bottom of the sidewall **25i**. The sidewall **25i** has a cylindrical shape and has such a size as to surround the side surface of the disc **100** stored in the disc storage portion. The sidewall **25i** is discontinued by three notches **25d, 25g** and **25h**. The disc supporting portion **25a** has a flat ring shape including a notch **25c**. As the first and second shutters **21** and **22** are opened, the rotational member **25** is rotated, thereby overlapping the notch **25c** with the head opening **11h**. A protrusion **25m** for moving the shielding member **24** is provided near the notch **25d**.

As described above, the convex portions **25e** and **25f**, which protrude toward the lower shell **11**, are provided on the lower surface of the disc supporting portion **25a**. Furthermore, an opener/closer **25j**, which engages with the shutter opening/closing mechanism of a disc drive, is provided on the outer side surface of the sidewall **25i**. Alternatively, where

the shutter opening/closing mechanism of the disc drive has a gear shape, a gear may be provided on the outer side surface of the sidewall **25i** instead of the opener/closer **25j**.

The shielding member **24** is disposed inside the notch **12g** of the inner side surface **12i** of the cartridge body **10**. The structure and operation of the shielding member **24** will be described in detail later.

The respective members of the disc cartridge **320** are assembled in such a manner as satisfy the vertical positional relationship shown in FIG. **104**. As a result, the lower and upper shells **11** and **12** are joined together so that the first and second shutters **21** and **22** are disposed on the lower shell **11** and that the rotational member **25** is located over the shutters **21** and **22**.

FIG. **105** is a plan view illustrating the disc cartridge **320** with the upper shell **12** thereof removed. FIG. **106** is a cross-sectional view of the disc cartridge **320** taken along the line **F-F** shown in FIG. **105**. The first and second shutters **21** and **22** are now closed.

As shown in FIG. **105**, the disc holder **22a** of the second

shutter **22** holds the disc **100** thereon inside the notch **25d** of the rotational member **25**. The disc **100** is also held by the disc holders **21b** and **22b** of the first and second shutters **21** and **22** inside the notches **25g** and **25h** of the rotational member **25**, respectively.

The opener/closer **25j** of the rotational member **25** is located inside the opening **11r** of the lower shell **11**. The protrusions **35** and **36** of the first and second shutters **21** and **22** protrude into the center hole **100h** of the disc **100**. The center of rotation of the rotational member **25** substantially matches with the center of the disc **100**. That is to say, the rotational member **25** is disposed inside the disc storage portion so as to rotate substantially around the center of the disc **100**.

The shafts **37** and **38** of the first and second shutters **21** and **22** are located under the disc supporting portion **25a** of the rotational member **25**. As shown in FIG. **106**, there is almost no gap between the top of the sidewall **25i** of the rotational member **25** and the bottom of the upper surface **12d** of the upper shell **12**, thus regulating the vertical movement

of the rotational member **25**. Accordingly, the rotational member **25** can effectively prevent the shafts **37** and **38** of the first and second shutters **21** and **22** from being raised and disengaged from the holes **39** of the lower shell **11** when the first and second shutters **21** and **22** rotate.

As shown in FIG. **106**, the disc supporting portion **25a** of the rotational member **25** has a sloped upper surface **25k**, and therefore, the disc **100** is in contact with only a portion of the upper surface **25k** of the disc supporting portion **25a** near the sidewall **25i**. In such a structure, even if the ring-shaped disc supporting portion **25a** has its width increased to increase the mechanical strength of the rotational member **25**, the upper surface **25k** is in contact with only a portion of the signal recording side **100A** of the disc **100** around its outer periphery. Thus, the signal recording area is hardly in contact with the disc supporting portion **25a**. It should be noted that the top of that portion of the disc supporting portion **25a** that is in contact with the disc **100** is located at the same vertical level as the top of the convex portions **21w** and **22w** of the first and second shutters **21** and **22**.

Next, it will be described how the first and second shutters **21** and **22** that is going to be closed or opened mount or dismount the disc **100** thereon/therefrom. FIG. **107** is a plan view illustrating the respective positions of the first and second shutters **21** and **22** and the rotational member **25** in a state where the first and second shutters **21** and **22** are closed. FIG. **108** is a cross-sectional view of the disc cartridge **320** taken along the line **G-G** shown in FIG. **107**. FIG. **109** is a plan view illustrating the respective positions of the first and second shutters **21** and **22** and the rotational member **25** in a state where the first and second shutters **21** and **22** are opened. FIG. **110** is a cross-sectional view of the disc cartridge **320** taken along the line **H-H** shown in FIG. **109**. In FIGS. **107** and **109**, the disc **100** is indicated by the two-dot chain.

As shown in FIG. **107**, while the first and second shutters **21** and **22** are closed, the disc holders **21b**, **22a** and **22b** protrude through the notches **25g**, **25d** and **25h** of the sidewall **25i** of the rotational member **25** toward the center of the disc **100**, thereby holding the disc **100** thereon. As shown in FIG.

108, the disc holders **22a** and **22b** have downwardly tapered slopes **22a'** and **22b'** that are in contact with the outer edge of the first side **100B** of the disc **100**. Thus, the disc holders **22a** and **22b** press the disc **100** not only toward the center thereof but also toward the first and second shutters **21** and **22**. Although not shown, the other disc holder **21b** is also in the same state. As a result, a portion of the signal recording side **100A** of the disc **100** around the outer periphery thereof contacts with the disc supporting portion **25a**. Also, as already described for the twelfth preferred embodiment, the convex portions **21w** and **22w** of the first and second shutters **21** and **22** contact with a portion of the signal recording side **100A** of the disc **100** near the center hole **100h** thereof (not shown). In this manner, the signal recording area on the signal recording side **100A** of the disc **100** is shut off from the open air by the disc supporting portion **25a** of the rotational member **25** and by the convex portions **21w** and **22w** of the first and second shutters **21** and **22**. Consequently, no dust or fine particles will be deposited on, or no scratches will be created on, the signal recording area.

The hole **20h** defined by the first and second shutters **21** and **22** has a diameter approximately equal to that of the center hole **100h** of the disc **100**. Accordingly, even if this disc cartridge **320** is left upside down with the first and second shutters **21** and **22** thereof closed, no part of the signal recording side **100A** of the disc **100** will be exposed inside the hole **20h** of the first and second shutters **21** and **22**. For that reason, no dust or fine particles will be deposited on the signal recording side **100A** of the disc **100**.

To open the first and second shutters **21** and **22**, the opener/closer **25j** is engaged with the shutter opening/closing mechanism of the disc drive, and is turned to the direction indicated by the arrow **25A**. Then, the rotational member **25** starts to rotate inside the disc storage portion and the protrusions **25e** and **25f** also start to rotate around the center of the disc **100**. The protrusions **25e** and **25f** are engaged with the guide grooves **27e** and **28f**, respectively. Accordingly, the protrusions **25e** and **25f** rotating go inside the guide grooves **27e** and **28f** in the directions indicated by the arrows **27E** and **28F**, respectively, while pressing the sidewalls of the guide

grooves **27e** and **28f**. As the sidewalls of the guide grooves **27e** and **28f** are pressed by the protrusions **25e** and **25f**, the first and second shutters **21** and **22** rotate on the shafts **37** and **38** to the directions indicated by the arrows **21A** and **22A**, respectively.

The disc holder **21b** also starts to rotate on the shaft **37** to the direction indicated by the arrow **21A**, while the disc holders **22a** and **22b** start to rotate on the shaft **38** to the direction indicated by the arrow **22A**. Thus, the disc holders **21b**, **22a** and **22b** go away from the disc **100** and release the disc **100**.

As the first and second shutters **21** and **22** are opened, the protrusions **35** and **36** on the first and second shutters **21** and **22** also rotate to the directions **21A** and **22A**, respectively. In the meantime, the disc **100** does not move. Accordingly, the protrusions **35** and **36** contact with the non-signal recording area **100e** on the signal recording side **100A** of the disc **100**. The protrusions **35** and **36** are located at a vertical level higher than that of the convex portions **21w** and **22w**. Thus, while the protrusions **35** and **36** are in contact with the signal

recording side **100A**, the convex portions **21w** and **22w** are out of contact with the signal recording side **100A**. Consequently, it is possible to prevent the convex portions **21w** and **22w** from scratching the signal recording side **100A**, or the signal recording area thereof, in particular.

As the rotational member **25** is rotated to a certain degree, the protrusions **25e** and **25f** will soon reach the ends of their guide grooves **27e** and **28f**, respectively, as shown in FIG. **109**. Then, the first and second shutters **21** and **22** will be fully opened to expose the head and chucking openings **11h** and **11c** entirely.

At that time, the notch **25c** of the disc supporting portion **25a** of the rotational member **25** is aligned with the head opening **11h**, and no part of the disc supporting portion **25a** is exposed inside the head opening **11h**. Accordingly, when the first and second shutters **21** and **22** are fully opened, the head of the disc drive can access the disc **100** easily and is not interfered with by the rotational member **25**.

Also, as shown in FIGS. **109** and **110**, even when the first and second shutters **21** and **22** are opened, the protrusions **35**

and **36** of the first and second shutters **21** and **22** are still in contact with the non-signal recording area **100e** on the signal recording side **100A** of the disc **100**. Thus, the signal recording area will not get scratched by the protrusions **35** and **36**.

To close the shutters **21** and **22**, the respective members should be moved in the opposite directions. That is to say, as the first and second shutters **21** and **22** are closed, the disc holders **21b**, **22a** and **22b** are getting closer to the disc **100** and eventually hold the disc **100** thereon. These operations have already been described in detail for the eighth through thirteenth preferred embodiments, and the description thereof will be omitted herein.

Next, the structure and operation of the shielding member **24** will be described. As shown in FIG. **111**, the shielding member **24** includes a sidewall **24d** and a pair of shafts **24b** provided at the ends of the sidewall **24d**. At the bottom of the sidewall **24d**, a first contacting portion **24a** is provided. The first contacting portion **24a** needs to contact with the outer side surface of the disc **100** and has a curved

surface having the same radius of curvature as the outer side surface of the disc **100**. The backside of the sidewall **24d** is a second contacting portion **24f**. An arm **24c** is provided near each of the shafts **24b** and has a third contacting portion **24e** at the end thereof.

As shown in FIG. **112**, the shielding member **24** is disposed at such a position that the shaft **24b** thereof is located between the upper surface **12d** of the upper shell **12** and the sidewall **25i** of the rotational member **25**. As indicated by the arrow **24A**, the shielding member **24** can swing on the shaft **24b**. A line that connects the respective centers of the shafts **24b** together is parallel to a tangent line defined with respect to the disc **100** and is located at a vertical level higher than the first side **100B** of the disc **100**.

FIGS. **113** and **114** illustrate cross sections of the shielding member **24** at one end and the center thereof while the first and second shutters **21** and **22** are closed. As shown in FIGS. **113** and **114**, the sidewall **24d** is pressed toward the center of the disc **100** so that the convex portion **25m** of the rotational member **25** contacts with the second contacting

portion **24f** of the shielding member **24** and that the first contacting portion **24a** contacts with the outer side surface of the disc **100**. Thus, no dust or dirt will reach the signal recording side **100A** of the disc **100** by way of the notch **25c** of the disc supporting portion **25a** (see FIG. **104**). In this manner, the disc supporting portion **25a** and the shielding member **24** are in contact with the outer periphery of the disc **100** continuously, thereby preventing the dust or dirt from reaching the signal recording side **100A**.

As the rotational member **25** is rotated to open the first and second shutters **21** and **22**, the convex portion **25m** of the rotational member **25** goes away from the shielding member **24**. As a result, no force is applied to the shielding member **24** toward the disc **100** anymore.

As the first and second shutters **21** and **22** are further opened and as the rotational member **25** is further rotated, the outer side surface of the sidewall **25i** of the rotational member **25** will soon contact with the third contacting portion **24e** of the shielding member **24**, thereby pressing the sidewall **24d** outward. FIGS. **115** and **116** illustrate cross sections of

the shielding member **24** at one end and the center thereof. As shown in FIG. **115**, the outer side surface of the disc **100** has been out of contact with the first contacting portion **24a** of the shielding member **24**. As a result, the disc **100** is now rotatable inside the disc storage portion.

In this manner, the shielding member **24** swings as the rotational member **25** is rotated, thereby alternately coming into contact with the outer side surface of the disc **100** and out of contact with the outer side surface of the disc **100** to allow the disc **100** to rotate freely.

As described above, in this preferred embodiment, the label side **100B** of the disc **100** is displayed inside the disc cartridge **320**. Thus, the disc cartridge **320** can have a good design and a reduced thickness.

In addition, the first and second shutters **21** and **22** can be opened and closed by rotating the rotational member **25**. While the shutters **21** and **22** are closed, the disc **100** can be held firmly by the disc holders **21b, 22a** and **22b**.

Furthermore, while the disc **100** is held inside the disc storage portion, the label side **100B** of the disc **100** is

exposed. Even so, the disc supporting portion **25a** of the rotational member **25**, the protrusions **21w** and **22w** of the first and second shutters **21** and **22**, and the shielding member **24** interlocked with the rotational member **25** together protect the signal recording side **100A** of the disc **100** from dust, dirt or scratches.

In the twentieth preferred embodiment described above, the opening **11r** is provided on one side surface of the lower shell **11** so that the opener/closer **25j** for use to rotate the rotational member **25** is operated on the side surface that is adjacent to another side surface thereof including the head opening **11h**. Alternatively, the opener/closer **25j** may be provided on any other side surface of the cartridge body **10**. As another alternative, a plurality of opener/closers may be provided as well. For example, the opener/closer **25j** of the preferred embodiment described above may be used as a first opener/closer and a protrusion may be provided as a second opener/closer for the sidewall **25i** of the rotational member **25** so as to be located inside the head opening **11h**. Optionally, as shown in FIG. **105**, a protrusion **49** may be provided as a

second opener/closer near the disc holder **22a** of the second shutter **22** so that the second shutter **22** can be operated directly. In that case, as the second shutter **22** is moved, the rotational member **25** rotates, thereby moving the first shutter **21** synchronously.

In the twentieth preferred embodiment described above, the shielding member **24** prevents dust from reaching the signal recording side **100A** of the disc **100** by way of the notch **25c** of the disc supporting portion **25a**. Alternatively, any other structure may be used to prevent dust from entering the disc cartridge **320** through the notch **25c**.

For example, as schematically illustrated in FIG. **117**, the notch **12g** of the inner side surface **12i** of the cartridge body **10** may be closed up by extending the inner side surface **12i**, and the disc holder **22b** of the second shutter **22** (not shown) may be disposed at a position that is symmetrical to the notch **12g** with respect to the center of the disc **100**. Just like the disc holder of the thirteenth preferred embodiment described above, the disc holder **22b** needs to be movable toward the center of the disc **100** and an elastic force

needs to be applied to the disc holder **22b** toward the center of the disc **100**, too. As another alternative, as in the disc holder of the nineteenth preferred embodiment described above, an elastic member may be provided for a portion of the disc holder **22b** that contacts with the disc **100** so that the elastic force applied therefrom presses the disc **100** toward the center thereof as shown in FIG. **118**.

Specifically, such a disc holder **22b** contacts with the disc **100** and holds it thereon, thereby pressing the outer side surface of the disc **100** toward the notch **25c** of the inner side surface **12i** of the cartridge body **10**. The sizes of the disc storage portion and the disc **100** are almost equal to each other. Accordingly, the radius of curvature of the inner side surface **12i** is approximately equal to that of the outer side surface of the disc **100**. As a result, the outer side surface of the disc **100** closely contact with the inner side surface **12i** of the cartridge body **10**. Thus, the inner side surface **12i** and the disc supporting portion **25a** together prevent dust from reaching the signal recording side **100A** of the disc **100**.

Such a structure needs no shielding member **24,** thus simplifying the structure of the disc cartridge.

EMBODIMENT 21

Hereinafter, a disc cartridge according to a twenty-first specific preferred embodiment of the present invention will be described. FIG. **120** is a plan view illustrating the back surface of the disc cartridge **321** of this preferred embodiment. FIGS. **121** and **122** are side views of the disc cartridge **321** as viewed in the directions indicated by the arrows **121** and **122**, respectively. Although not shown clearly in FIG. **120,** the disc cartridge **321** also includes a rotational member **25,** a shielding member **24,** a first shutter **21,** a second shutter **22** and a disc stopper **23,** each of which may have the same structure as the counterpart of the disc cartridge **320** of the twentieth preferred embodiment described above. Since the functions of these members have already been described for the twentieth preferred embodiment, the description thereof will be omitted herein.

As shown in FIGS. **120, 121** and **122,** the disc cartridge **321** includes a groove **55** and a pair of concave portions **10c,**

which are provided on two side surfaces of the cartridge body **10** thereof. The disc cartridge **321** further includes a write-protect mechanism **56** near another side surface of the cartridge body **10**, which is opposed to a third side surface thereof with the head opening **11h**. Hereinafter, these members will be described in detail.

As shown in FIG. **120**, the cartridge body **10** of the disc cartridge **321** includes: two side surfaces **10q** and **10r** that are parallel to each other; a side surface **10p** with the head opening **11h**; and a side surface **10u** that is opposed to the side surface **10p**. In this preferred embodiment, the four corners of the cartridge body **10** are all rounded. Accordingly, there are no edges that definitely divide the four side surfaces. For example, there is no clearly defined boundary between the side surfaces **10p** and **10q**. However, a boundary between two adjacent side surfaces is herein supposed to exist near a rounded corner. More specifically, the side surface **10u** includes: a center portion **10u′** that crosses the side surfaces **10q** and **10r** substantially at right angles; and two sloped portions **10u″** that define a predetermined tilt angle

with the center portion **10u'**.

As shown in FIGS. **120** and **121**, the groove **55** is provided on the side surface **10q**, through which the opener/closer **25j** of the rotational member **25** protrudes, and extends almost along the length of the side surface **10q**. The bottom **55a** of the groove **55** includes an opening **11r** that is provided for the side surface **10q**. The opening **11r** defines a region in which the opener/closer **25j** moves to open or close the shutters **21** and **22**. The opener/closer **25j** protrudes through the groove **55** and engages with the shutter opening/closing mechanism of the disc drive. Thus, as the shutter opening/closing mechanism slides along the groove **55**, the shutters **21** and **22** can open or close.

The concave portions **10c** are provided for the two opposed side surfaces **10q** and **10r** and are located near the side surface **10u**. The concave portions **10c** pass through the back surface **10t** of the cartridge body **10** but do not reach the upper surface **10h** of the cartridge body **10**. As shown in FIG. **121**, the concave portion **10c** of the side surface **10q** is provided so as to divide the groove **55** into two.

While the disc cartridge **321** is being loaded into a changer, the concave portions **10c** get engaged with roller-like or tab-like gripping structures, which are provided in such a manner as to sandwich the disc cartridge **321** between them. In this preferred embodiment, the concave portions **10c** on the side surfaces **10q** and **10r** have the same shape. Alternatively, the concave portion **10c** on the side surface **10r** may have a different shape from the concave portion **10c** on the other side surface **10q**. If the two concave portions **10c** have mutually different shapes, then the gripping structures of the disc drive can engage with the disc cartridge **321** only when the disc cartridge **321** is inserted correctly (i.e., with upside up and downside down).

FIG. **123** illustrates the structure of a portion of the disc cartridge **321** near the concave portion **10c** on the side surface **10q** of the cartridge body **10**. As shown in FIG. **123**, the concave portion **10c** is deeper than the groove **55** as measured from the side surface **10q**. That is to say, the distance from the side surface **10q** to the bottom **10c′** of the concave portion **10c** is greater than the distance from the side

surface **10q** to the bottom **55a** of the groove **55**. To create no steps between the bottoms **55a** and **10c'**, a sloped portion **55a'** is provided between the bottom **55a** of the groove **55** and the bottom **10c'** of the concave portion **10c**. The angle ϕ defined by the sloped portion **55a'** with the bottom **10c'** of the concave portion **10c** is preferably about 20 degrees to about 40 degrees, more preferably about 30 degrees. The reason is as follows. Specifically, if the angle ϕ defined by the sloped portion **55a'** with the bottom **10c'** of the concave portion **10c** is over about 40 degrees, then the end of the shutter opening/closing mechanism **57** will get stuck in the concave portion **10c** and will not move easily. On the other hand, if the angle ϕ defined by the sloped portion **55a'** with the bottom **10c'** of the concave portion **10c** is under about 20 degrees, then the sloped portion **55a'** might be too long to be located between the concave portion **10c** and the opening **11r**. Also, the side surface **10c"** of the concave portion **10c** is closer to the upper surface **10h** of the cartridge body **10** than the side surface of the groove **55**.

Next, it will be described how the shutter

opening/closing mechanism **57** slides along the groove **55**. After the disc cartridge **321** has been loaded into the disc drive or while the disc cartridge **321** is being loaded into the disc drive, the shutter opening/closing mechanism **57** of the disc drive engages with the groove **55** of the disc cartridge **321**. Then, the shutter opening/closing mechanism **57** moves along the groove **55** in the direction indicated by the arrow **55A** while pressing its end against the bottom **55a** of the groove **55**. Once the end of the shutter opening/closing mechanism **57** has interlocked with the opener/closer **25j**, the opener/closer **25j** also moves as the shutter opening/closing mechanism **57** moves. In this manner, the shutters **21** and **22** are opened. When the shutters **21** and **22** are fully opened, the opener/closer **25j** reaches the end of the opening **11r** and cannot advance in the direction **55A** any farther. Thus, the end of the shutter opening/closing mechanism **57** disengages itself from the opener/closer **25j**.

If the shutter opening/closing mechanism **57** further keeps going in the same direction **55A** after that, the end of the shutter opening/closing mechanism **57** will be pressed against

the sloped portion **55a'** of the groove **55** and come into contact with the bottom **10c'** of the concave portion **10c** and then the second sloped portion **55a'** adjacent to the side surface **10u**. Thereafter, the shutter opening/closing mechanism **57** finally leaves the groove **55**. As described above, the sloped portions **55a'** are provided so as to define a predetermined angle with the bottom **10c'** of the concave portion **10c**. Accordingly, the shutter opening/closing mechanism **57** can move smoothly between the bottom **55a** of the groove **55** and the bottom **10c'** of the concave portion **10c**, which are located at mutually different depths as measured from the side surface **10q**.

If the user commands the disc drive to unload (or eject) the disc cartridge **321**, then the shutters **21** and **22** are closed by the opposite operations before the disc cartridge **321** starts to be unloaded or while the disc cartridge **321** is being unloaded. Specifically, the shutter opening/closing mechanism **57** gets engaged with the groove **55** of the cartridge body **10** by way of the side surface **10u** thereof and moves along the groove **55** in the direction indicated by the arrow **55B** while pressing its end against the bottom **55a** of the groove **55**.

That is to say, the end of the shutter opening/closing mechanism **57** moves while contacting with the second sloped portion **55a'** of the groove **55**, the bottom **10c'** of the concave portion **10c** and then the first sloped portion **55a'** of the groove **55**. Thereafter, the end of the shutter opening/closing mechanism **57** soon interlocks with the opener/closer **25j** while sliding on the bottom **55a** of the groove **55**. Once the end of the shutter opening/closing mechanism **57** has interlocked with the opener/closer **25j**, the opener/closer **25j** moves in the same direction **55B** as the shutter opening/closing mechanism **57**. In this manner, the shutters **21** and **22** are closed. When the shutters **21** and **22** are fully closed, the opener/closer **25j** reaches the end of the opening **11r** and cannot advance in the same direction **55B** any farther. Thus, the end of the shutter opening/closing mechanism **57** disengages itself from the opener/closer **25j**. Thereafter, the shutter opening/closing mechanism **57** leaves the groove **55**.

In the disc cartridge **321** with such a structure, no steps are formed between the bottom **10c'** of the concave portion **10c** and the bottom **55a** of the groove **55**. Thus, the

shutter opening/closing mechanism **57** can slide along the groove **55** smoothly because the end of the shutter opening/closing mechanism **57** will not be caught in the concave portion **10c**. Accordingly, there is no need to accurately define the sliding range of the shutter opening/closing mechanism **57** (e.g., such that the shutter opening/closing mechanism **57** will not go as far as the concave portion **10c**). Thus, the movement of the shutter opening/closing mechanism **57** can be controlled more easily and/or no additional control mechanism, which is sometimes required to control the movement of the shutter opening/closing mechanism **57** accurately, is needed anymore.

On the other hand, the bottom **10c′** of the concave portion **10c** is deeper than the bottom **55a** of the groove **55** as described above. Also, the side surface **10c″** of the concave portion **10c** is located closer to the upper surface **10h** of the cartridge body **10** than the side surface of the groove **55**. Thus, the concave portion **10c** can engage with the gripping structure of the changer in an increased area. In other words, the gripping structure of the changer can grip the

disc cartridge **321** by the concave portions **10c** just as intended. As a result, loading errors can be reduced significantly. That is to say, the gripping structure of the changer almost never fails to grip the disc cartridge **321** and rarely drops the disc cartridge **321** during the loading operation.

Also, the concave portion **10c** passes through the back surface **10t** of the cartridge body **10** but does not reach the upper surface **10h** thereof. Accordingly, if a tray is provided for the disc drive to insert and eject the disc cartridge **321** into/from the disc drive by getting its protrusions engaged with, and disengaged from, the concave portions **10c**, the disc cartridge **321** mounted upside down on the tray cannot be loaded into the disc drive. This is because the protrusions on the tray do not engage with the upper surface **10h** of the disc cartridge **321**. In this manner, the concave portions **10c** can be used as means for distinguishing the recto and verso of the disc cartridge **321**.

In the cartridge body **10** of this disc cartridge **321** in particular, the groove **55** is provided near the disc storage

portion thereof, and cannot be so deep. However, when the concave portion **10c** is simply added to compensate for the insufficient depth of the groove **55**, a dead space is left inside the concave portion **10c**. Accordingly, by providing the sloped portions **55a'** for the bottom **55a** of the groove **55**, the concave portion **10c** can increase its depth appropriately according to the specific shape of the gripping structure without allowing the shutter opening/closing mechanism **57** to be locked onto the steps between the bottom **55a** of the groove **55** and the bottom **10c'** of the concave portion **10c**.

In the preferred embodiment described above, the concave portion **10c** is provided on the side surface **10q** in such a manner as to divide the groove **55** into two. Alternatively, the concave portion **10c** may be located at the end of the groove **55** as long as the concave portion **10c** is continuous with the groove **55**. In that case, the sloped portion **55a'** is provided at the connection between the groove **55** and the concave portion **10c**.

Next, the write-protect mechanism **56** will be described. As shown in FIG. **124**, the write-protect mechanism **56** includes:

an elongated hole **58**, which is provided on the back surface **10t** of the cartridge body **10**; and a sliding member **59** with a raised portion **59a** that protrudes through the elongated hole **58**. The elongated hole **58** extends parallelly to the sloped portion **10u″** of the side surface **10u** of the cartridge body **10**, and includes a first circular decision region **58a** and a second circular decision region **58b**. The raised portion **59a** has a flat circular top, which is parallel to the back surface **10t** of the cartridge body **10** and which is larger in diameter than the first or second decision region **58a** or **58b**. The elongated hole **58** has a shape corresponding to the trace of the raised portion **59a** moving.

The first decision region **58a** and the second decision region **58b** of the disc cartridge **321** correspond to first and second decision regions of another type of disc cartridge according to a different set of specifications, if the disc cartridge **321** is overlapped with another type of disc cartridge, such that the center of the disc stored in the disc cartridge **321** matches with that of the disc stored in the DVD-RAM disc cartridge and that the insert directions of

these two disc cartridges are matched with each other (i.e., front sides of the two disc cartridges face the same direction). In another type of disc cartridge, the first decision region is used to determine whether the disc stored therein is writable or unwritable. For example, the disc may be unwritable when the first decision region is open but may be writable when the first decision region is closed.

The second decision region of another type of disc cartridge is used to read the disc information that is uniquely defined according to its specifications. Specifically, in the case where another type of disc cartridge is a DVD-RAM disc cartridge, the DVD-RAM disc cartridge is designed in such a manner as to be insertable into a disc drive either upside up or upside down. Also, the DVD-RAM disc cartridge accepts both single-sided discs and double-sided discs. Accordingly, the second decision region is used to determine whether the side of the disc that faces this region is the signal recording side or not. For example, if the second decision region is open, the side of the disc facing this region is a non-active side, or not a signal

recording side. On the other hand, if the second decision region is closed, the side of the disc facing this region is an active side, i.e., a signal recording side.

As shown in FIG. **124**, the first and second decision regions **58a** and **58b** are arranged vertically to the inserting direction of the disc cartridge **321** (i.e., parallelly to the center portion **10u'** of the side surface **10u**). Accordingly, the direction in which the elongated hole **58** extends is not parallel to, but intersects with, the direction in which the first and second decision regions **58a** and **58b** are arranged.

However, when the sliding member **59** is located at such a position that the raised portion **59a** thereof is in contact with one end of the elongated hole **58**, the raised portion **59a** covers the first decision region **58a** of the elongated hole **58** almost entirely as indicated by the bold circle in FIG. **124**. On the other hand, when the sliding member **59** is located at such a position that the raised portion **59a** thereof is in contact with the other end of the elongated hole **58**, the raised portion **59a** covers the second decision region **58b** of the elongated hole **58** almost entirely as indicated by the

dashed circle in FIG. **124**.

FIG. **125** is an exploded perspective view of the write-protect mechanism **56**. As shown in FIG. **125**, the sliding member **59** includes the cylindrical raised portion **59a** and a lever **59b**. The lever **59b** is inserted into the opening **58c** of the sloped portion **10u″** of the side surface **10u** and used to slide the sliding member **59**. By moving the lever **59b** in one direction, the first decision region **58a** of the elongated hole **58** may be opened while the second decision region **58b** thereof may be closed as shown in FIG. **126**. Conversely, the first decision region **58a** of the elongated hole **58** may be closed and the second decision region **58b** thereof may be opened as shown in FIG. **127** by moving the lever **59b** in the opposite direction.

In this manner, if the sliding member **59** is slid in either direction by operating the lever **59b**, the first decision region **58a** of the disc cartridge **321** can be selectively opened or closed. Accordingly, if the disc drive, accepting both the disc cartridge **321** and another type of disc cartridge, for example, includes a first sensor switch that senses the loaded disc as either writable or unwritable by

checking out the state of the first decision region of another type of disc cartridge, the disc drive can also sense the disc in the disc cartridge **321** as writable or unwritable. That is to say, the single sensor switch of the same disc drive can detect the specific status of the disc that is stored in either of the two different types of disc cartridges. In this manner, the disc drive can detect the write protect state by a much simplified mechanism and can be manufactured at a significantly reduced cost.

On the other hand, if the disc drive includes a second sensor switch to detect the state of the second decision region of another type of disc cartridge, the second sensor switch may also check out the state of the second decision region **58b** of the elongated hole **58** in the disc cartridge **321**. In that case, the second sensor switch detects either contact with the raised portion **59a** as shown in FIG. **126** or no contact with the raised portion **59a** but an opening as shown in FIG. **127**. Thus, the second sensor switch will not contact with, or be damaged by, any other member of the disc cartridge **321**. Furthermore, when the disc cartridge **321** is loaded into the

disc drive, the result obtained by the second sensor switch may be used to sense the type of the disc cartridge loaded or the disc stored therein.

In the first through nineteenth preferred embodiments described above, a nonwoven fabric is ultrasonic welded or adhered to the shutters. However, if the disc has some anti-scratching structure (e.g., if the signal recording side of the disc is covered with a stiff hard coating), then the nonwoven fabric does not have to be attached thereto, but the shutters may directly contact with the disc. Also, not the entire surface of the shutters has to contact with the signal recording side of the disc, but the shutters may have such a structure that at least portion of the shutters contacts with the signal recording side of the disc. That is to say, not the entire surface but just a portion of the surface of the shutters may be in contact with the disc. In that case, some anti-scratching structure (e.g., a nonwoven fabric) may be provided for only that portion contacting with the disc.

In the first through twenty-first preferred embodiments of the present invention described above, the disc **100** to be

stored in the disc cartridge has just one signal recording side **100A**. However, a single-sided disc like this is used for illustrative purposes only. This is because the disc cartridge of the present invention has such a structure as to expose one side of the disc stored therein and because a single-sided disc is best suited to the disc cartridge of that type. Thus, even a disc having two signal recording sides (i.e., a double-sided disc) may be appropriately stored in the disc cartridge of the present invention and may be loaded into a disc drive to read or write a signal therefrom/thereon. It should be noted, however, that where a double-sided disc is stored in the disc cartridge of the present invention, dust may be deposited on the exposed one of the two signal recording sides. Accordingly, in that case, some mechanism for preventing the unwanted dust deposition should be provided for the disc cartridge.

Also, in the first through twenty-first preferred embodiments described above, the size of the disc **100** is not particularly specified. This is because the disc cartridge of the present invention may accommodate a disc having a size of

12 cm or any of various other sizes.

Furthermore, in the first through twenty-first preferred embodiments described above, the disc cartridge is illustrated as having an outer dimension that is slightly greater than the size of the disc. However, the size relationship between the disc and the disc cartridge is not limited to the illustrated one. For example, even when the disc cartridge has an outer dimension that is large enough to store a 12 cm disc therein, the disc storage portion and the disc holders of the disc cartridge may have their sizes and structures defined in such a manner as to store an 8 cm disc. Such a disc cartridge may be used as an adapter for getting read and write operations performed on an 8 cm disc by a disc drive for a 12 cm disc.

The various features of the present invention as described for the first through twenty-first preferred embodiments may be combined appropriately. For example, the rotation stoppers as described for the nineteenth preferred embodiment may be provided for the disc cartridge of the sixteenth preferred embodiment. Also, the recesses for use to

collect dust therein as described for the fifteenth preferred embodiment may be provided for the disc cartridge of the sixteenth preferred embodiment. As can be seen, the first through twenty-first preferred embodiments of the present invention may be modified or combined in numerous other ways and not all of those possible combinations or alternatives have been described herein. However, it is quite possible for those skilled in the art to conceive and carry out those various alternatives or combinations by reference to the description of the present application. Thus, it is intended by the appended claims to cover all of those modifications or combinations of the present invention that fall within the true spirit and scope of the present invention.

INDUSTRIAL APPLICABILITY

A disc cartridge according to any of various preferred embodiments of the present invention described above can be used particularly effectively to store a disc having only one signal recording side. The cartridge body of the disc cartridge has such a structure as to cover only the signal

recording side of the disc and expose the other side thereof. Thus, the disc cartridge can have a reduced thickness. Also, the shutters of the disc cartridge are formed in such a shape as to cover the openings on just one side of the disc cartridge. Accordingly, the shutters can have a simplified structure and can be formed at a lower cost. In addition, the disc holders of the disc cartridge hold a disc thereon by pressing the disc against the shutters or the cartridge body. Thus, the disc will not move inconstantly inside the cartridge body and no dust will be deposited on the signal recording side of the disc. Furthermore, since the label side of the disc is displayed inside the disc window, the disc cartridge can also have a good design.

Thus, the present invention provides a thinner and highly dustproof disc cartridge of a good design that is applicable for use in various types of disc drives.

It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the

present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

CLAIMS

1. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc;

a first shutter and a second shutter, which are provided on the bottom of the disc storage portion to expose or cover the head opening; and

a rotational member, which is provided over the first and second shutters inside the disc storage portion and which is engaged with the first and second shutters in such a manner

as to open or close the first and second shutters when rotates inside the disc storage portion.

2. The disc cartridge of claim 1, wherein the center of rotation of the rotational member substantially matches with the center of the disc that is stored in the disc storage portion.

3. The disc cartridge of claim 2, wherein the rotational member includes: a disc supporting portion for supporting an outer edge of the second side of the disc thereon; and a notch provided for the disc supporting portion, the notch being located inside the head opening while the first and second shutters are opened.

4. The disc cartridge of claim 3, wherein while the first and second shutters are closed, the disc supporting portion contacts with the outer edge of the second side of the disc.

5. The disc cartridge of claim 1, wherein the first and second shutters each include a notch so as to define a hole in a region corresponding to a center hole of the disc while the first and second shutters are closed.

6. The disc cartridge of claim 5, wherein the first and second shutters include first and second convex portions around the notches of the first and second shutters, respectively.

7. The disc cartridge of claim 6, wherein the upper surface of the disc supporting portion of the rotational member and the upper surface of the first and second convex portions of the first and second shutters are located at substantially the same vertical levels.

8. The disc cartridge of claim 7, wherein the first and second shutters respectively include first and second protrusions that protrude into the center hole of the disc while the first and second shutters are closed.

9. The disc cartridge of claim 8, wherein the upper surface of the first and second protrusions of the first and second shutters is located at a vertical level higher than the upper surface of the first and second convex portions thereof.

10. The disc cartridge of claim 3, wherein the first and second shutters have their shafts under the disc supporting portion of the rotational member.

11. The disc cartridge of claim 10, wherein the disc supporting portion of the rotational member includes first and second protrusions that protrude toward the bottom of the disc storage portion, and

wherein the first and second shutters include first and second guide grooves that respectively engage with the first and second protrusions of the rotational member.

12. The disc cartridge of claim 1, wherein the rotational member has a sidewall that covers the outer side surface of the disc, and

wherein a first opener/closer is provided for the sidewall.

13. The disc cartridge of claim 12, wherein the head opening reaches a first side surface of the cartridge body, and

wherein the cartridge body has an opening on a second side surface thereof that is adjacent to the first side surface, and

wherein the first opener/closer is located inside the opening of the second side surface.

14. The disc cartridge of claim 13, wherein at least one of the first and second shutters includes a second opener/closer that protrudes from the head opening.

15. The disc cartridge of claim 1, wherein the first and second shutters include a number of disc holders, which contact with an outer edge and a surrounding portion of the disc and hold the disc thereon while the first and second

shutters are closed.

16. The disc cartridge of claim 15, wherein each said disc holder has a downwardly tapered slope.

17. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc;

a first shutter and a second shutter, which are provided on the bottom of the disc storage portion to expose or cover

the head opening; and

a rotational member, which is provided over the first and second shutters inside the disc storage portion and which rotates as the first and second shutters are opened or closed,

wherein the rotational member includes: a disc supporting portion for supporting an outer edge of the second side of the disc thereon while the first and second shutters are closed; and a notch provided for the disc supporting portion, the notch being located inside the head opening while the first and second shutters are opened.

18. The disc cartridge of claim 17, further comprising a shielding member, which is located inside the notch of the disc supporting portion while the first and second shutters are closed and which swings in a radial direction of the disc.

19. The disc cartridge of claim 18, wherein the shielding member contacts with the outer edge of the disc while the first and second shutters are closed.

20. The disc cartridge of claim 19, wherein the shielding member has a shaft that is located over the first side of the disc and that is parallel to a tangent line defined with respect to the disc.

21. The disc cartridge of claim 20, wherein the shielding member swings as the rotational member rotates.

22. The disc cartridge of claim 21, wherein the rotational member includes a sidewall that covers the outer side surface of the disc, and

wherein the shaft of the shielding member is located between an upper shell of the cartridge body and the rotational member.

23. The disc cartridge of claim 17, wherein the disc storage portion includes a sidewall along an outer periphery of the bottom, and

wherein one of the first and second shutters includes a disc holder for applying an elastic force to the disc and

holding the disc thereon in such a manner that the outer edge of the disc contacts with the sidewall of the disc storage portion inside the notch of the rotational member while the first and second shutters are closed.

24. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc; and

at least one disc stopper, which is provided for the cartridge body so as to protrude into the disc window and

thereby prevent the disc from dropping through the disc window,

wherein the radius R1 of the disc and the radius R2 of a smallest circular opening, of which the center matches with the center of the disc window and which is in contact with the disc stopper, satisfy $14/15 \leqq R2/R1$.

25. The disc cartridge of claim 24, wherein the radii R1 and R2 satisfy $14/15 \leqq R2/R1 < 1$.

26. The disc cartridge of claim 24, further comprising another disc stopper,

wherein the two disc stoppers are arranged symmetrically with respect to the center of the disc window.

27. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is

rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc; and

a type recognizing region, which is provided for the cartridge body to recognize the type of the disc stored in the disc cartridge,

wherein the presence and absence of a concave portion in/from the type recognizing region represent two possible types of the disc stored in the disc cartridge.

28. The disc cartridge of claim 27, wherein the cartridge body further includes a positioning hole, which is engageable with a positioning pin of a disc drive, and

wherein the type recognizing region is provided near the positioning hole.

29. The disc cartridge of claim 27, wherein one of the two possible types of the disc to be stored in the disc cartridge has a single signal recording layer, while the other type of the disc has double signal recording layers, and

wherein if the disc stored in the disc cartridge has a single signal recording layer, then the concave portion is absent from the type recognizing region, and

wherein if the disc stored in the disc cartridge has double signal recording layers, then the concave portion is present in the type recognizing region.

30. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head

opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc;

a first shutter and a second shutter, which are provided on the bottom of the disc storage portion to expose or cover the head opening;

a groove, which is provided on, and extends along, a first side surface of the cartridge body;

an opener/closer, which protrudes through the bottom of the groove and which moves along the groove, thereby opening or closing the first and second shutters;

a first concave portion, which is provided on the first side surface of the cartridge body; and

a second concave portion, which is provided on a second side surface of the cartridge body, the second side surface being opposed to the first side surface,

wherein the first concave portion is continuous with the groove on the first side surface and has a bottom that is deeper than the bottom of the groove, and

wherein the bottom of the first concave portion and the bottom of the groove are connected together by a sloped surface that defines a predetermined angle with the bottom of the first concave portion.

31. The disc cartridge of claim 30, wherein the first concave portion passes through the back surface of the cartridge body but does not reach the upper surface of the cartridge body.

32. The disc cartridge of claim 31, wherein a side surface of the first concave portion, which crosses the bottom of the first concave portion, is located closer to the upper surface of the cartridge body than a side surface of the groove, which crosses the bottom of the groove.

33. The disc cartridge of claim 31, wherein the predetermined angle that is defined by the sloped surface with the bottom of the first concave portion is in the range of about 20 degrees to about 40 degrees.

34. A disc cartridge comprising:

a cartridge body including a disc storage portion, a chucking opening and a head opening, wherein the disc storage portion has a disc window and a bottom and stores a disc, having first and second sides, therein so that the disc is rotatable in the disc storage portion and that the disc exposes the first side inside the disc window; the chucking opening is provided on the bottom of the disc storage portion so as to get the disc chucked externally; and the head opening is also provided on the bottom of the disc storage portion so as to allow a head, which reads and/or writes a signal from/on the second side of the disc, to access the second side of the disc;

a first shutter and a second shutter, which are provided on the bottom of the disc storage portion to expose or cover the head opening; and

a write-protect mechanism, which is provided for the cartridge body,

wherein the write-protect mechanism includes:

an elongated hole, which is provided on the back surface

of the cartridge body and which includes a first region and a second region; and

a sliding member, which has a raised portion that protrudes through the elongated hole and which is supported such that the raised portion goes back and forth inside the elongated hole, and

wherein when the disc cartridge is overlapped with another disc cartridge, which complies with a different set of specifications and which also includes a first region and a second region, such that the center of the disc stored in the former disc cartridge matches with that of the disc stored in the latter disc cartridge and that insert directions of the two disc cartridges are matched with each other, the first region of the another disc cartridge for use to determine whether the disc stored therein is writable or unwritable overlaps with the first region of the disc cartridge almost completely and the second region of the another disc cartridge for use to read information unique to the disc stored therein also overlaps with the second region of the disc cartridge almost completely, the first and second regions of the another

disc cartridge being arranged in a direction that is perpendicular to the direction that the front sides of the two disc cartridges face, and

wherein a direction in which the elongated hole extends intersects with the direction in which the first and second regions of the another disc cartridge are arranged, and

wherein the sliding member goes back and forth inside the elongated hole such that the first region of the elongated hole is selectively opened or closed.

35. The disc cartridge of claim 34, wherein the cartridge body includes a side surface having a portion that is parallel to the elongated hole.

FIG.1

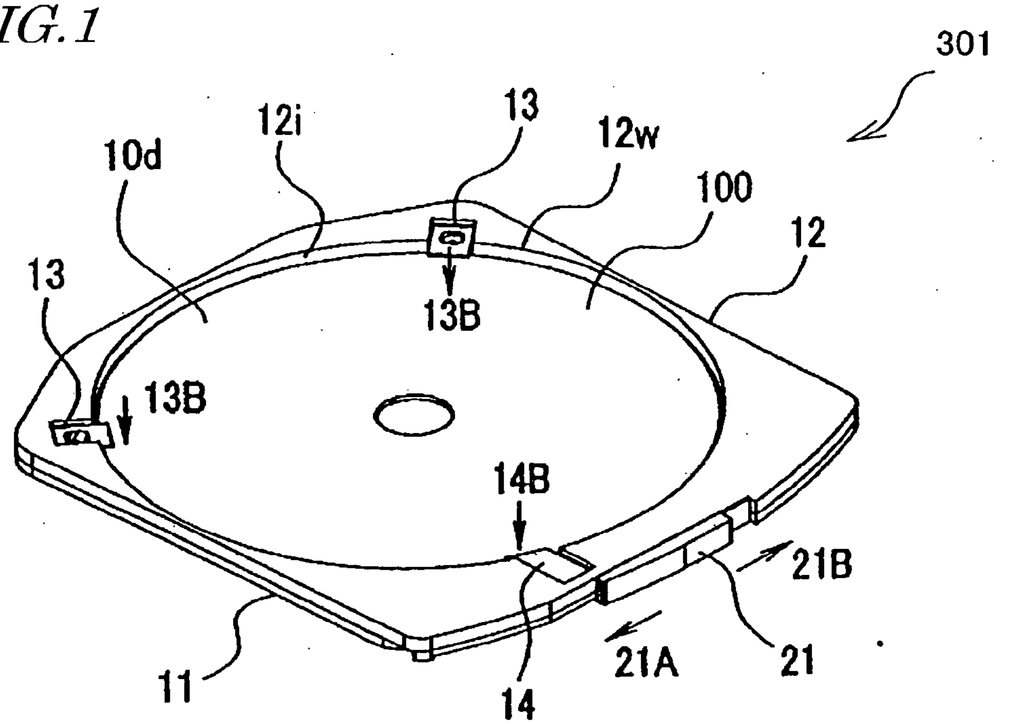

301
13
12i
12w
10d
100
12
13
13B
13B
14B
21B
11
14
21A
21

FIG.2

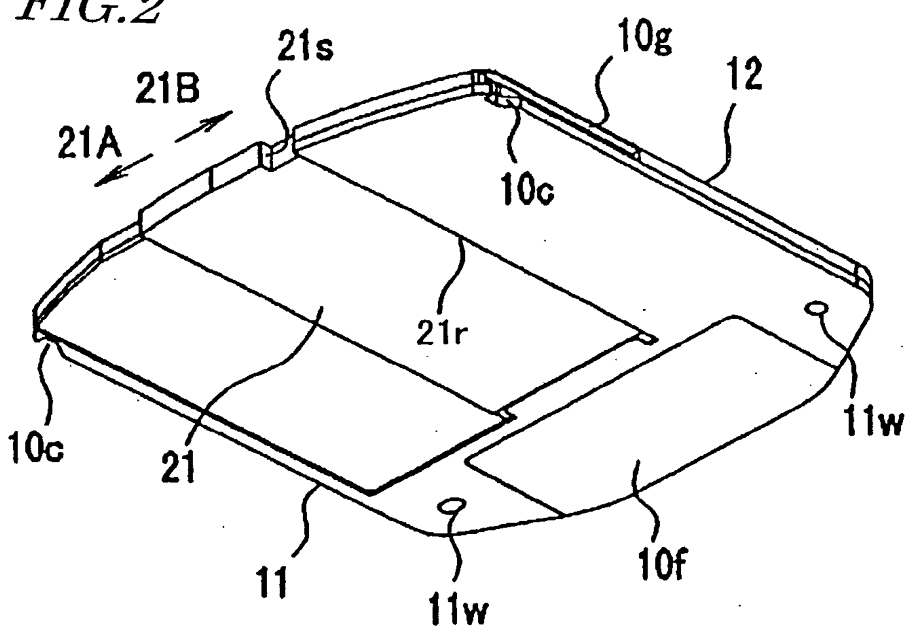

21s
10g
21B
12
21A
10c
21r
11w
10c
21
11
11w
10f

FIG.3

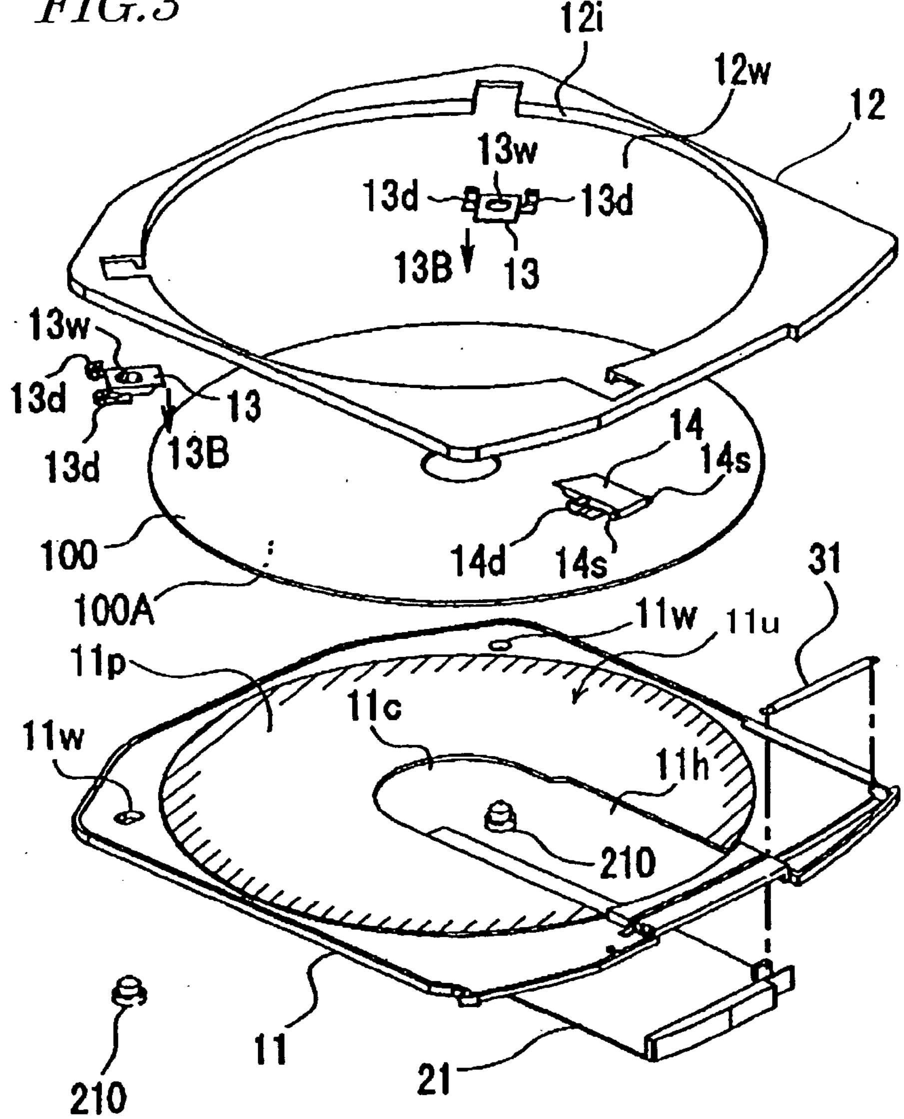

12i
12w
12
13w
13d
13d
13B
13
13w
13d
13
13d
13B
14
14s
100
14d
14s
31
100A
11w
11u
11p
11c
11w
11h
210
11
21
210

FIG.4

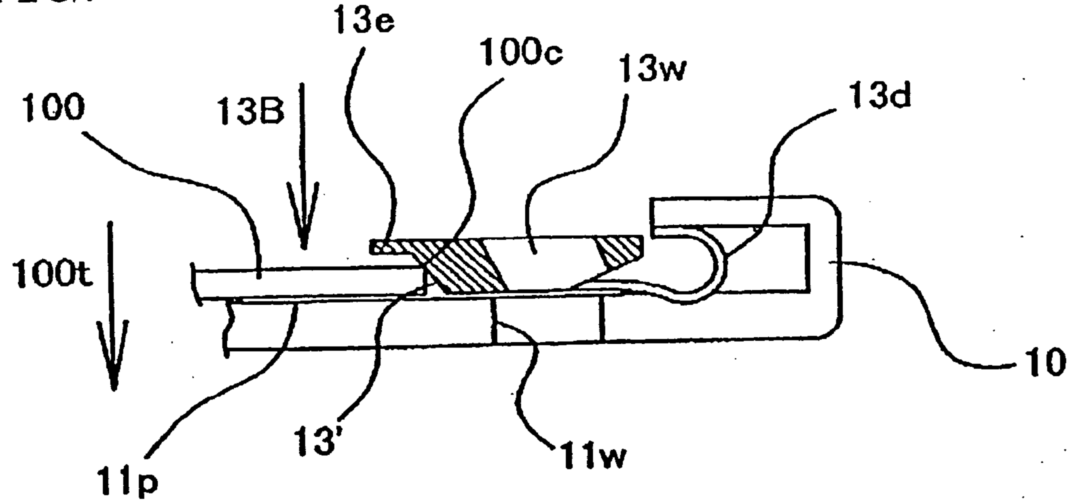

13e
100c
13w
13d
100
13B
100t
10
13'
11w
11p

FIG.5

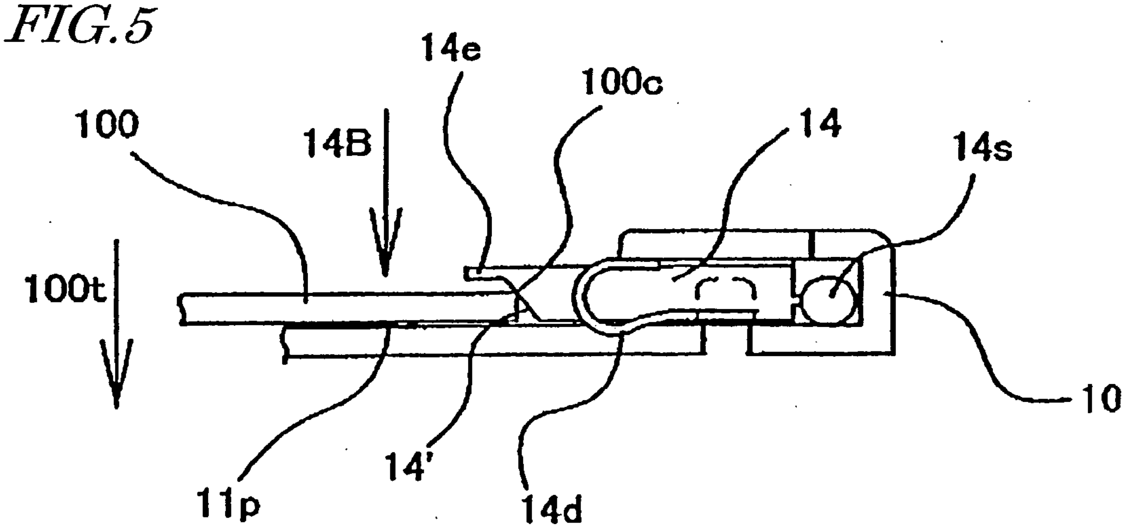

14e
100c
14
14s
100
14B
100t
10
14'
14d
11p

FIG.6

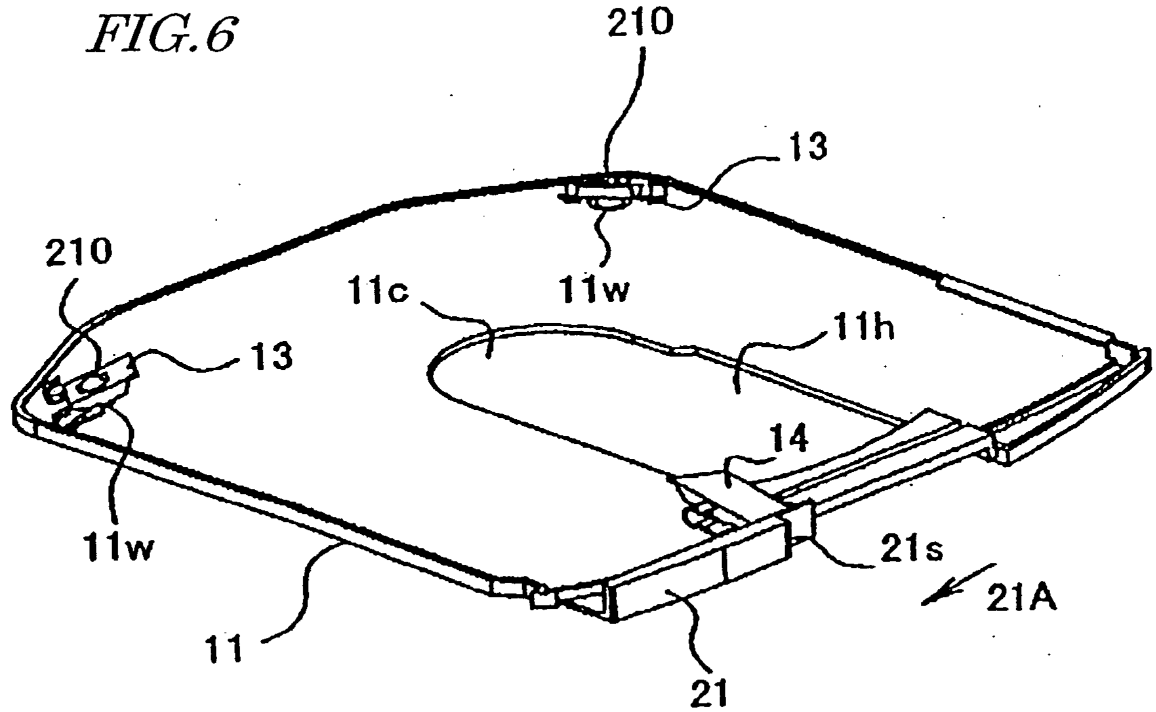

210
13
210
11c
11w
11h
13
14
11w
21s
21A
11
21

FIG.7

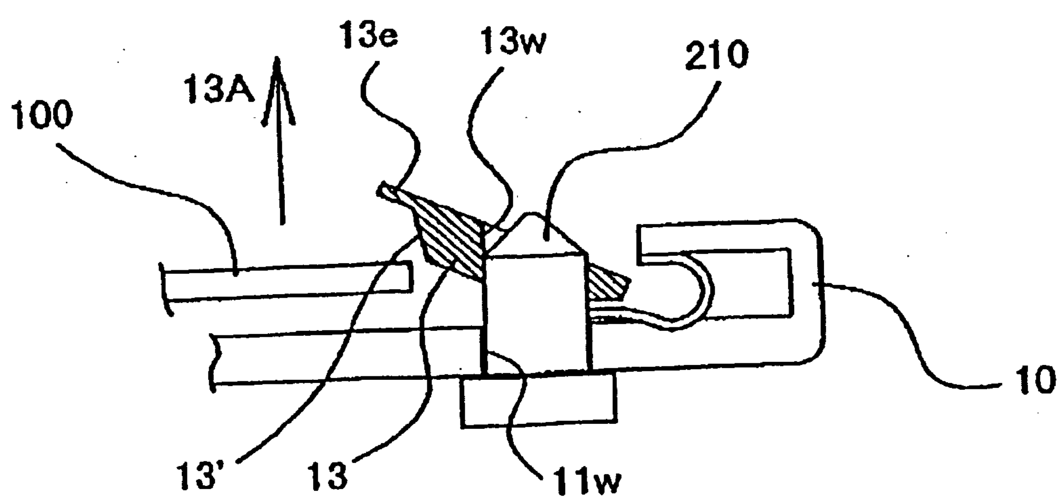

13e
13w
210
13A
100
10
13'
13
11w

FIG.8

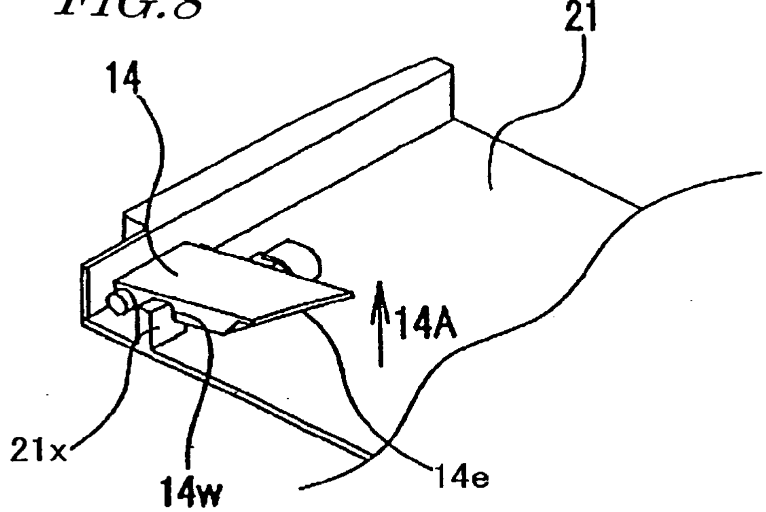

21
14
14A
21x
14w
14e

FIG.9

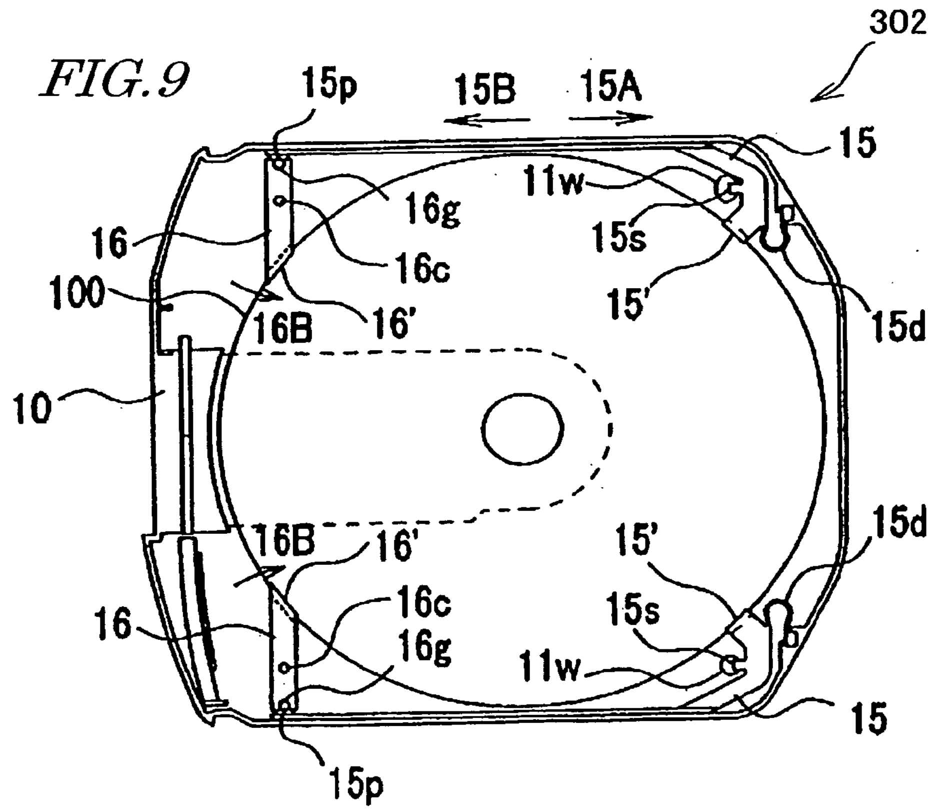

302
15p
15B
15A
15
11w
16g
16
15s
16c
100
16B
16'
15'
15d
10
16B
16'
15'
15d
16c
15s
16
16g
11w
15
15p

FIG.10

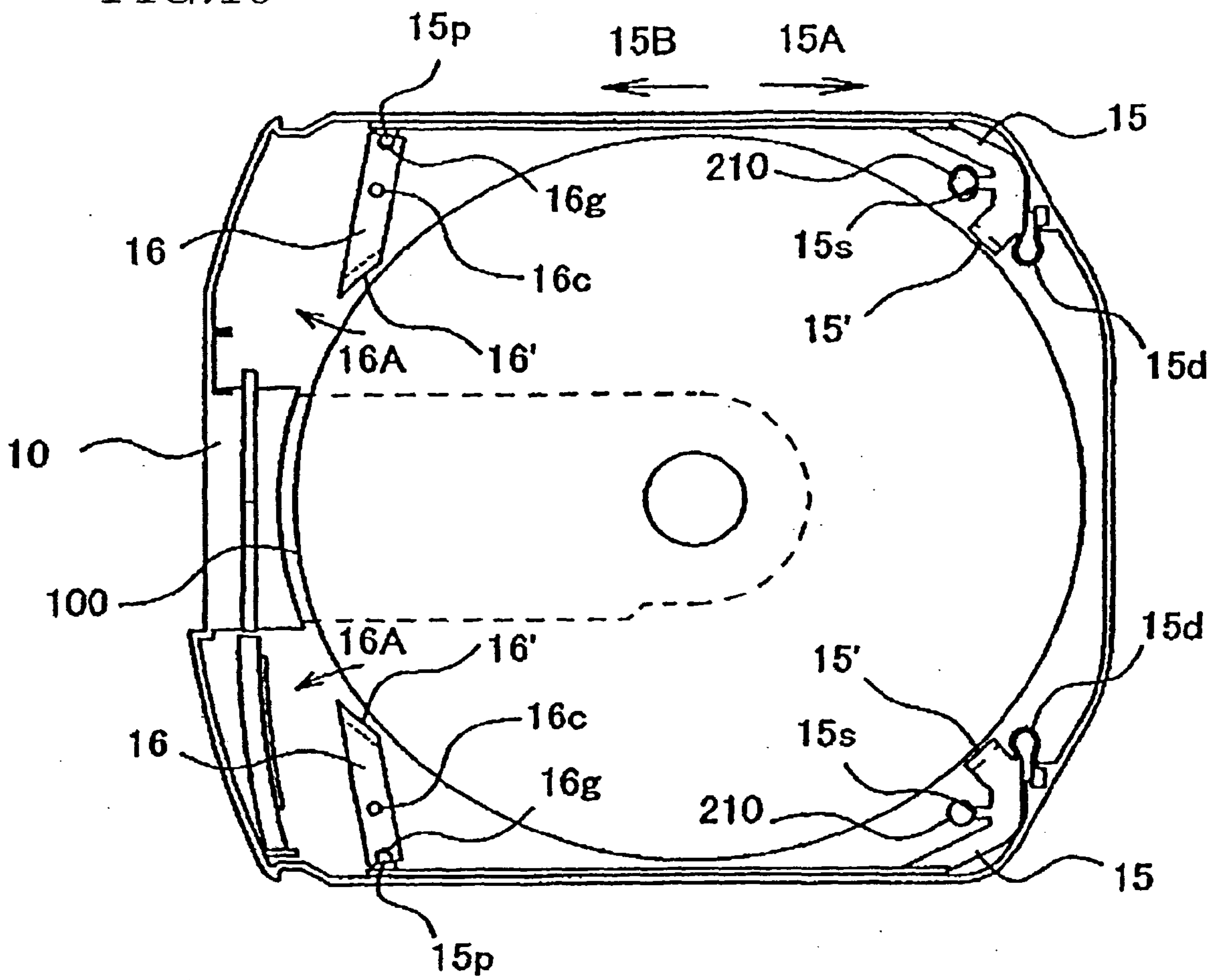

15p
15B
15A
15
210
16g
15s
16
16c
15'
16A
16'
15d
10
100
16A
16'
15d
15'
16c
15s
16
16g
210
15
15p

FIG. 11

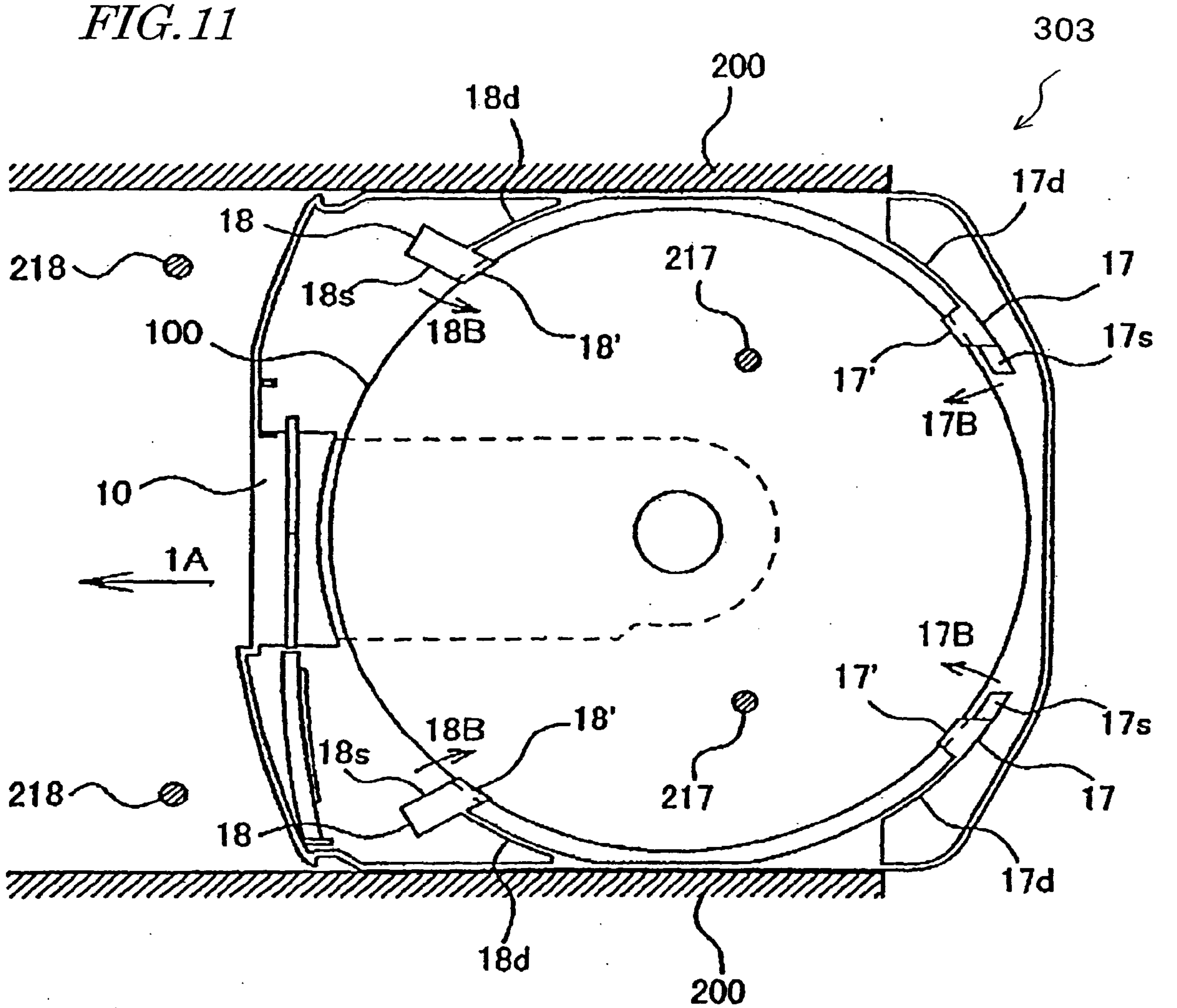

303
200
18d
17d
18
218
217
17
18s
18B
18'
100
17s
17'
17B
10
1A
17B
17'
17s
18B
18'
18s
218
217
17
18
17d
18d
200

FIG.12

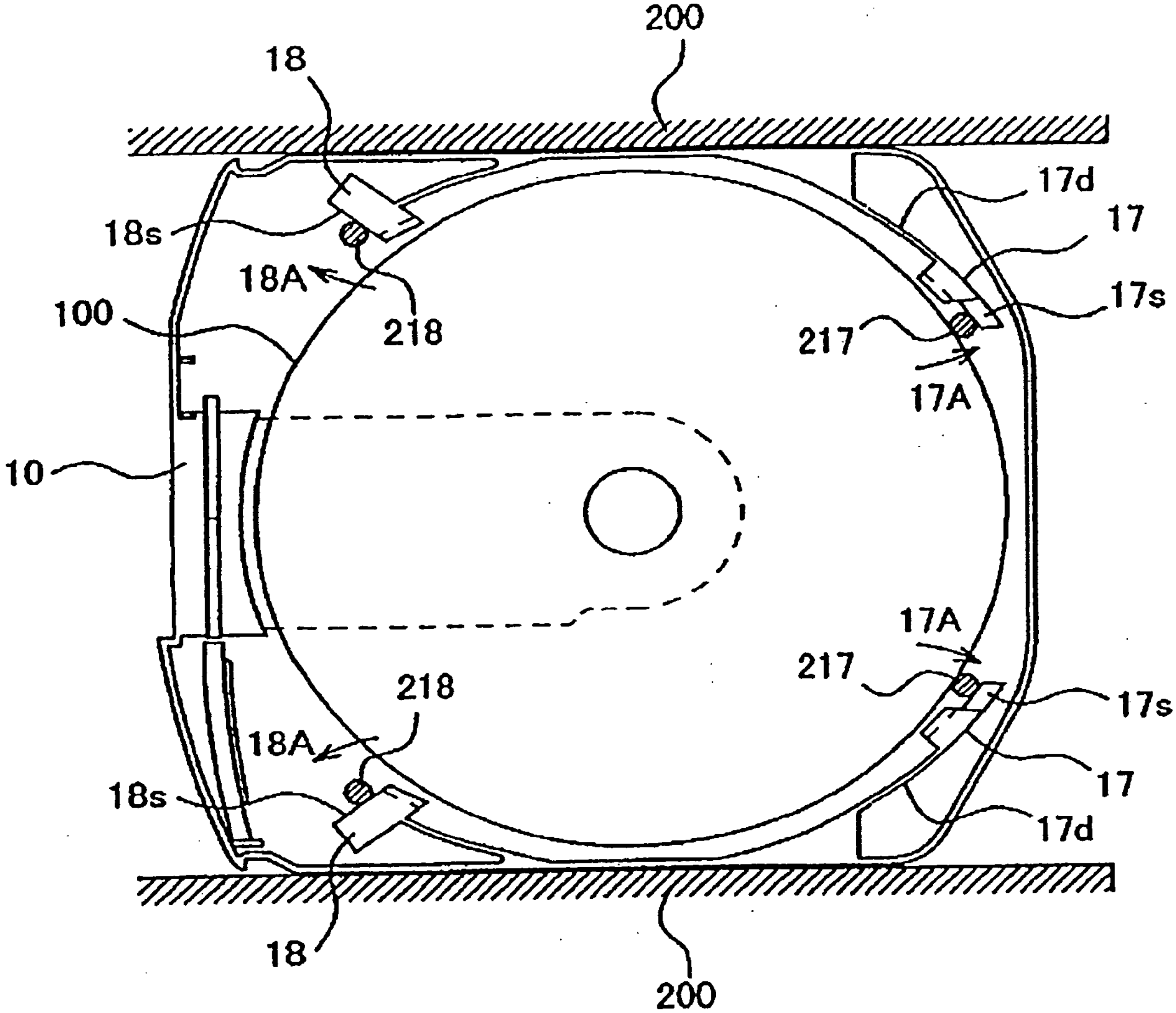

200
18
17d
17
18s
17s
18A
218
100
217
17A
10
17A
217
218
17s
18A
17
18s
17d
18
200

FIG.13

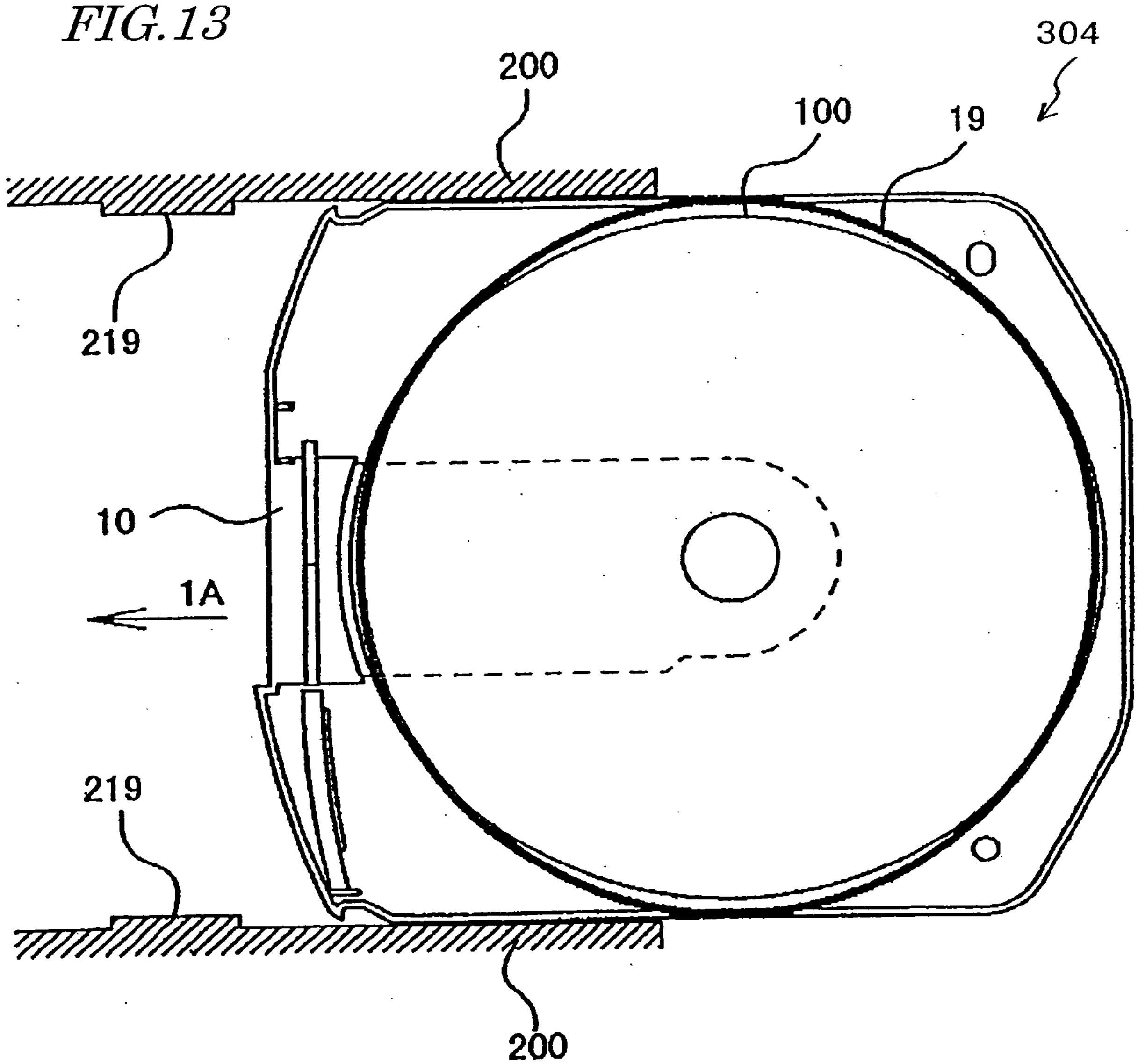


FIG.14

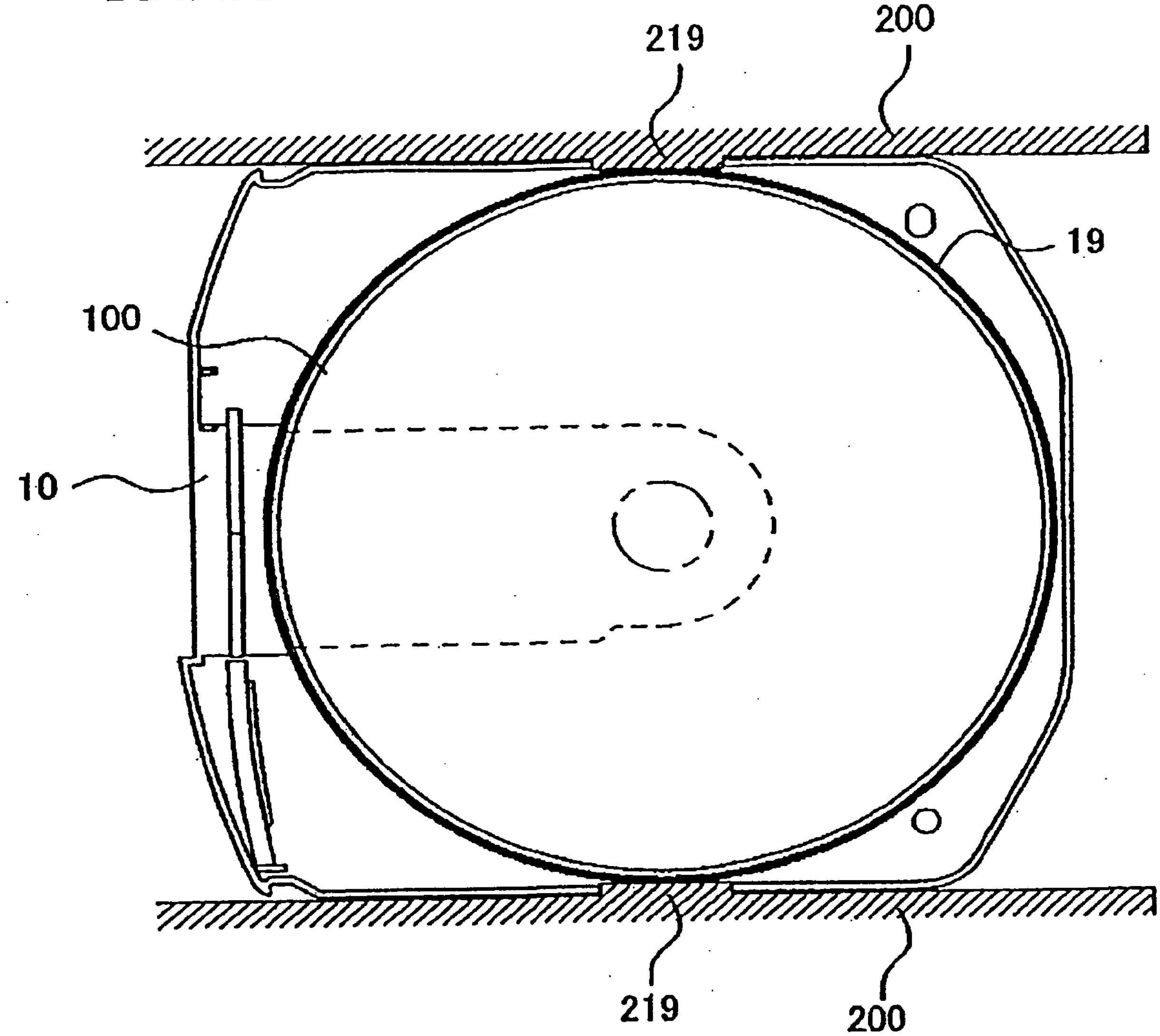


FIG.15

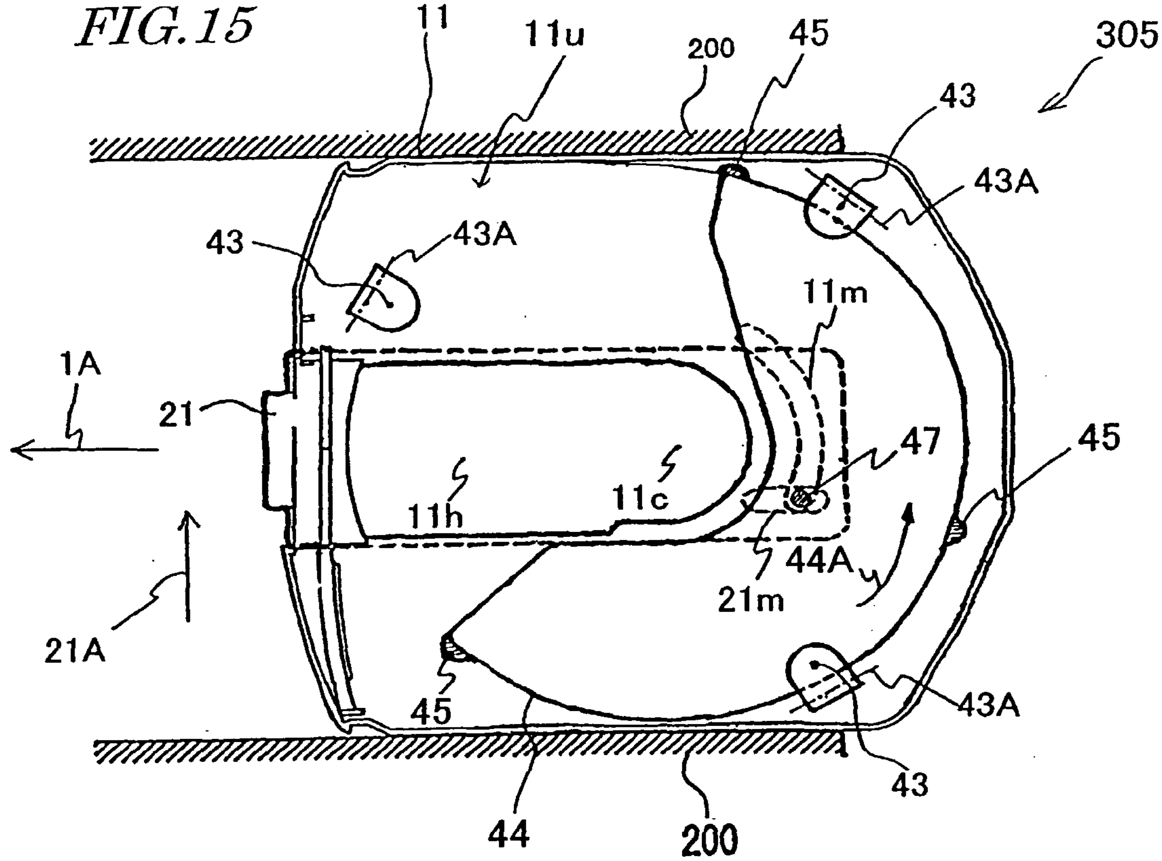

11
11u
200
45
305
43
43A
43
43A
11m
1A
21
47
45
11h
11c
44A
21m
21A
45
43A
44
200
43

FIG.16

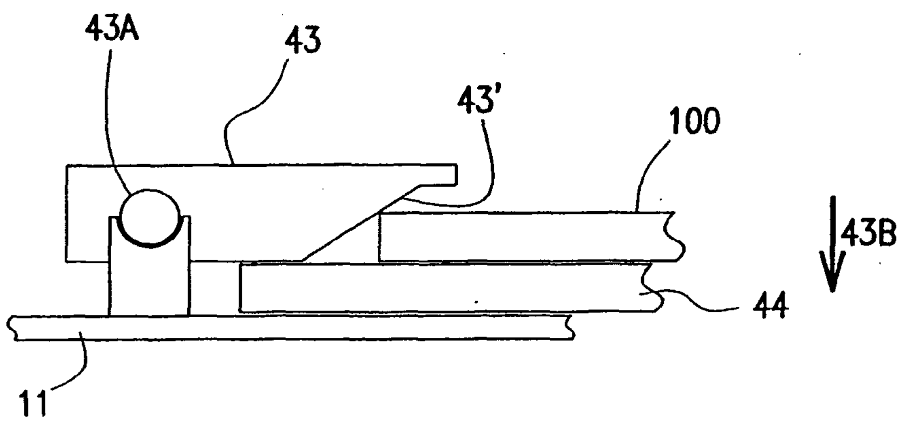

43A
43
43'
100
43B
44
11

FIG.17

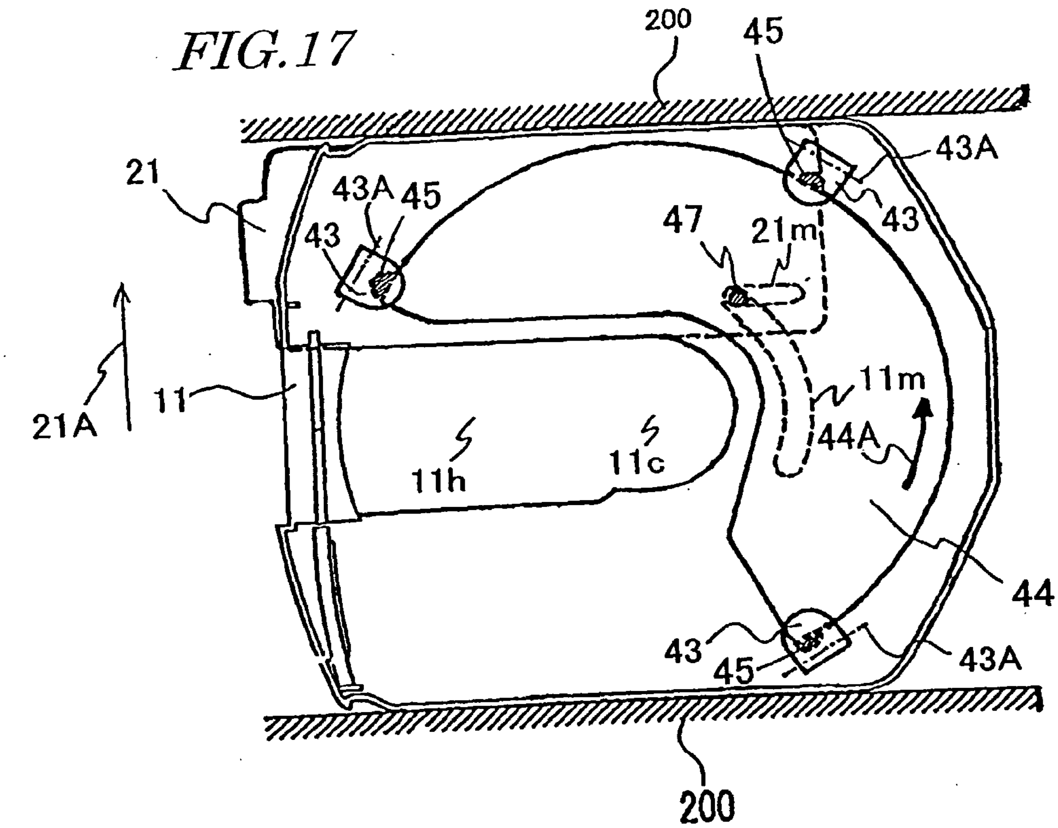

200
45
43A
21
43A
45
43
47
21m
43
11m
21A
11
44A
11h
11c
44
43
43A
45
200

FIG.18

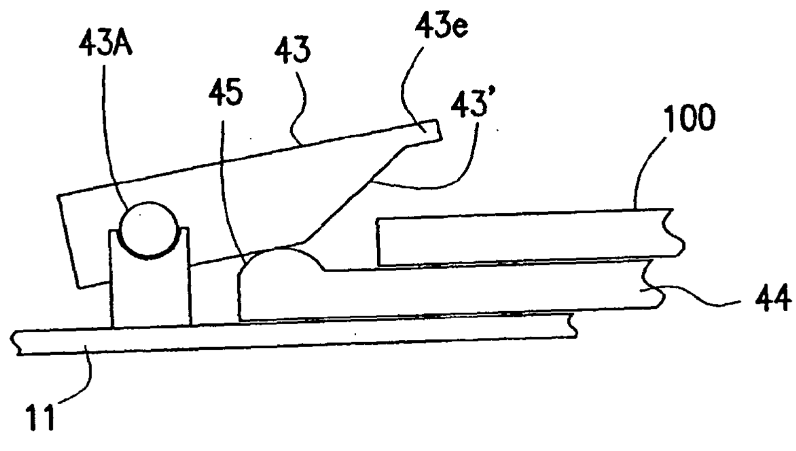
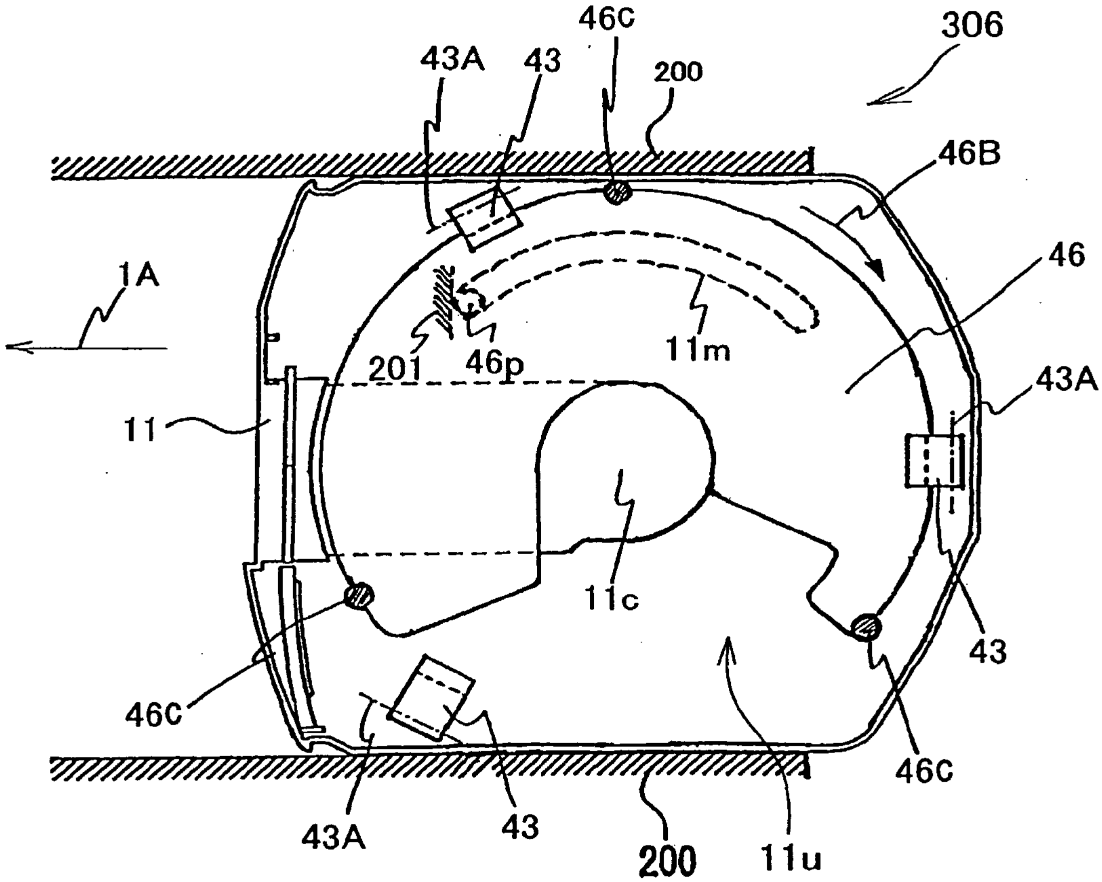

43A
43
43e
45
43'
100
44
11

FIG.19



306
46C
43A
43
200
46B
46
1A
201
46p
11m
43A
11
11c
43
46C
46C
43A
43
200
11u

FIG.20

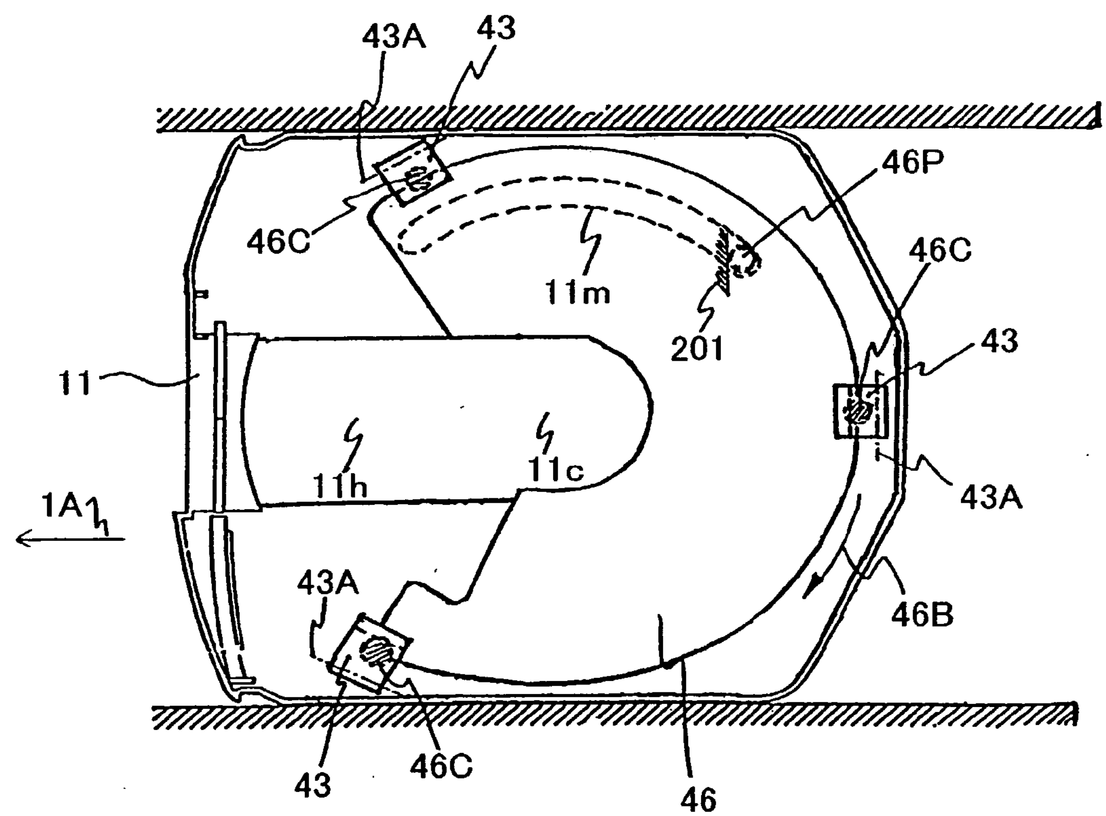
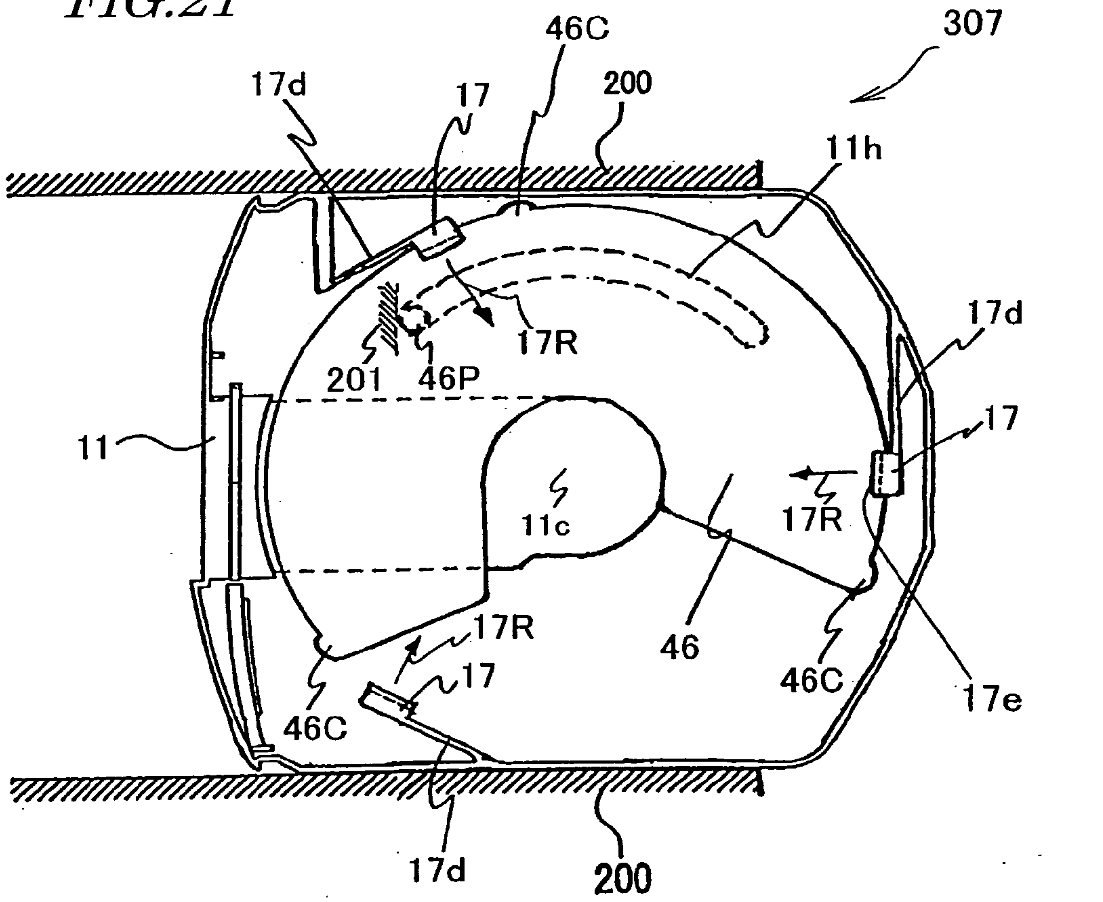


FIG.21



307
46C
200
17d
17
11h
17d
17R
201
46P
17
11
11c
17R
17R
46
17
46C
46C
17e
17d
200

FIG.22

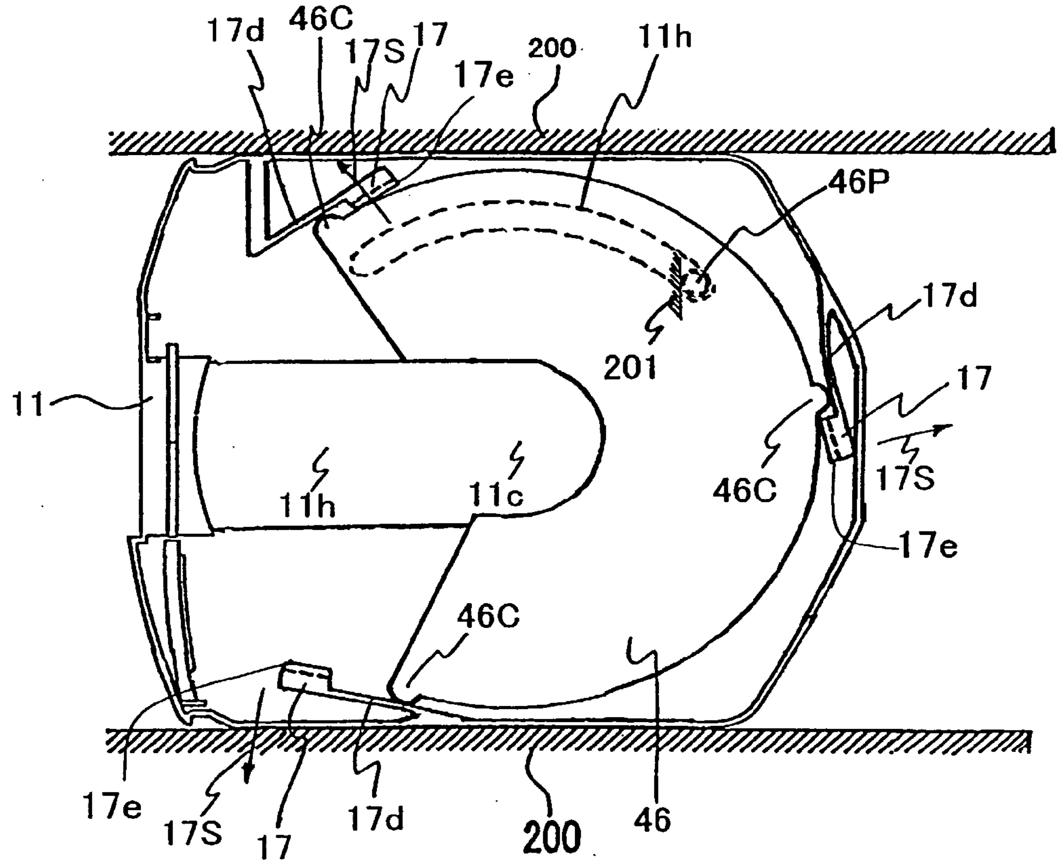

17d
46C
17S
17
17e
200
11h
46P
201
17d
17
11
11h
11c
46C
17S
17e
46C
17e
17S
17
17d
200
46

FIG.23

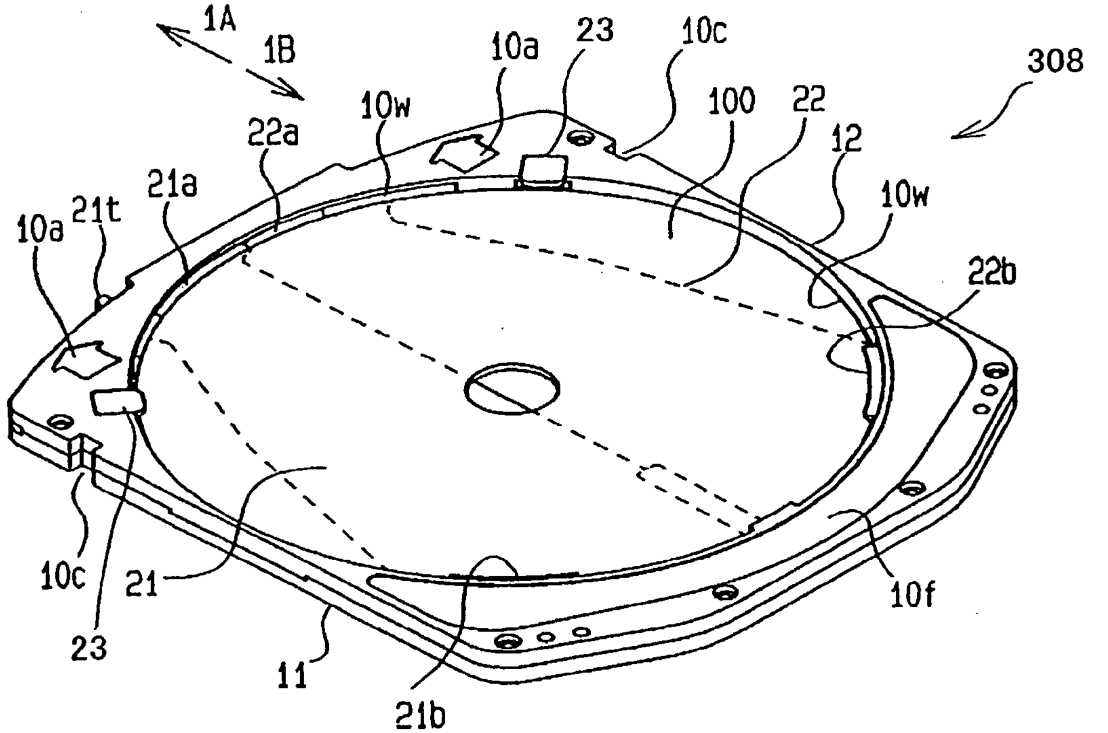

1A
1B
10a
23
10c
308
10w
100
22
22a
12
21a
21t
10a
10w
22b
10c
21
10f
23
11
21b

FIG.24

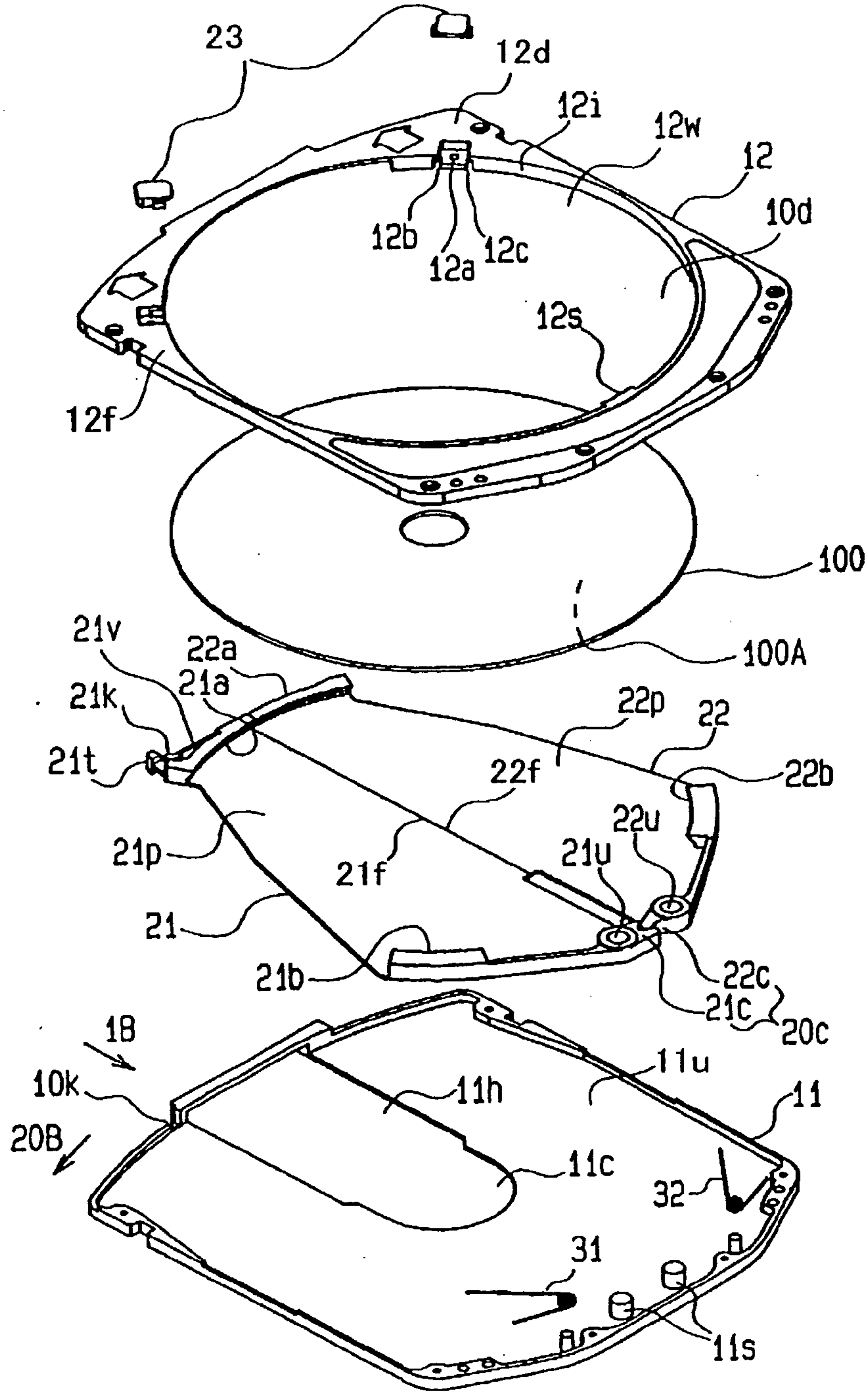

23
12d
12i
12w
12
10d
12b
12a
12c
12s
12f
100
100A
21v
22a
21a
21k
22p
22
21t
22b
22f
22u
21p
21f
21u
21
22c
21b
21c
20c
18
11u
10k
11h
11
20B
11c
32
31
11s

FIG.25

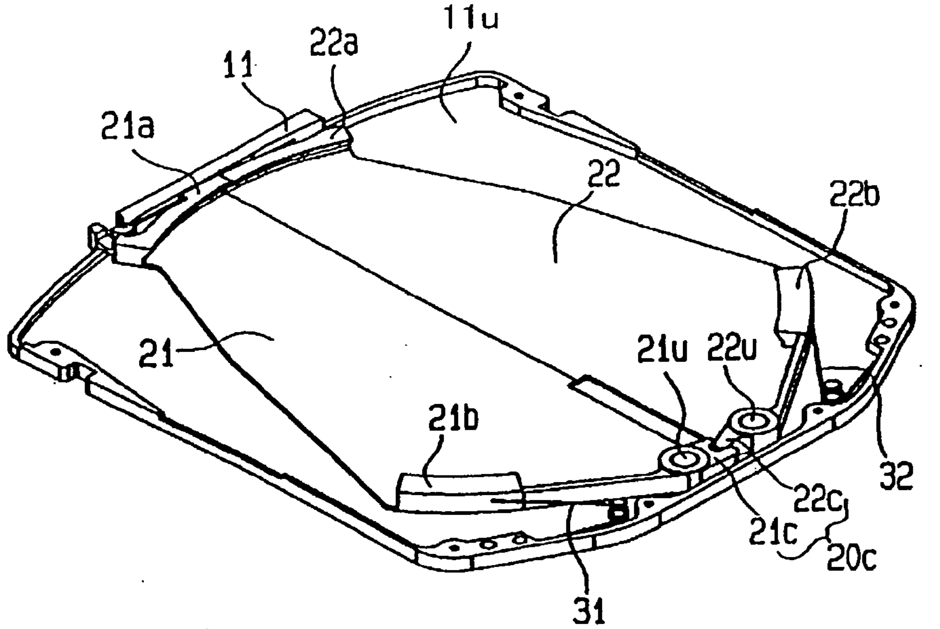

11u
22a
11
21a
22
22b
21
21u
22u
21b
32
22c
21c
20c
31

FIG.26

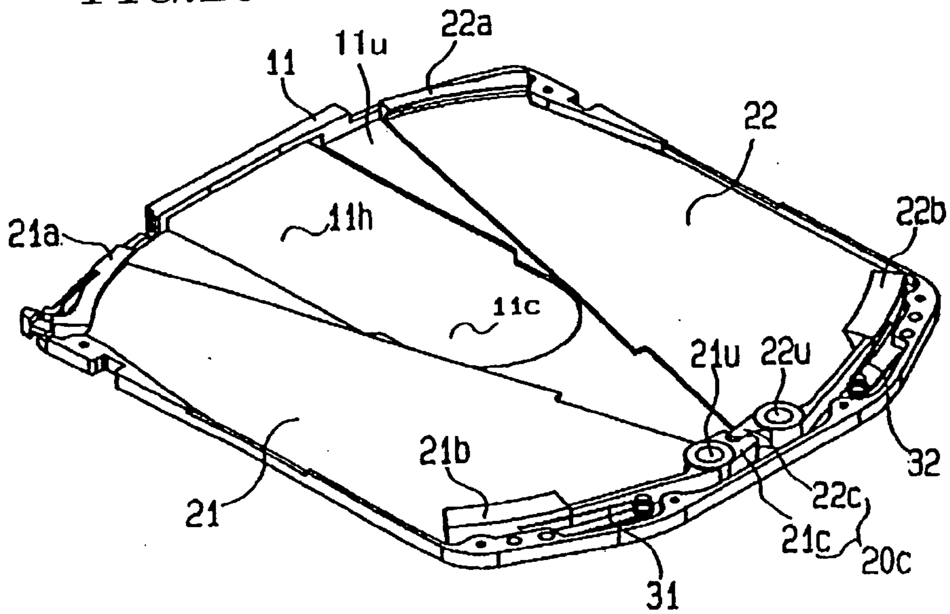

22a
11u
11
22
22b
21a
11h
11c
21u
22u
32
21b
22c
21
21c
20c
31

FIG.27

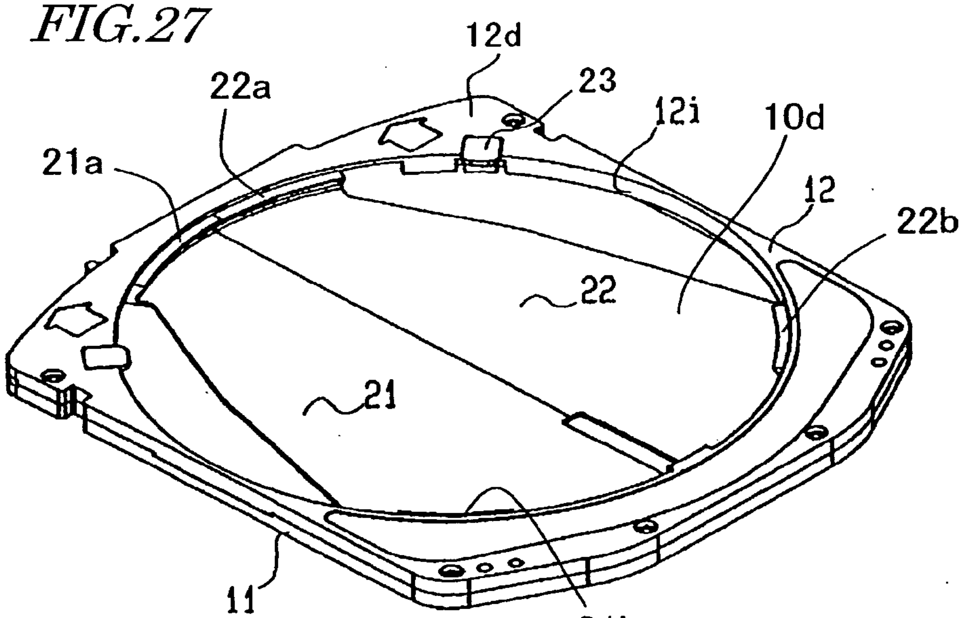

12d
23
22a
12i
10d
21a
12
22b
22
21
11
21b

FIG.28

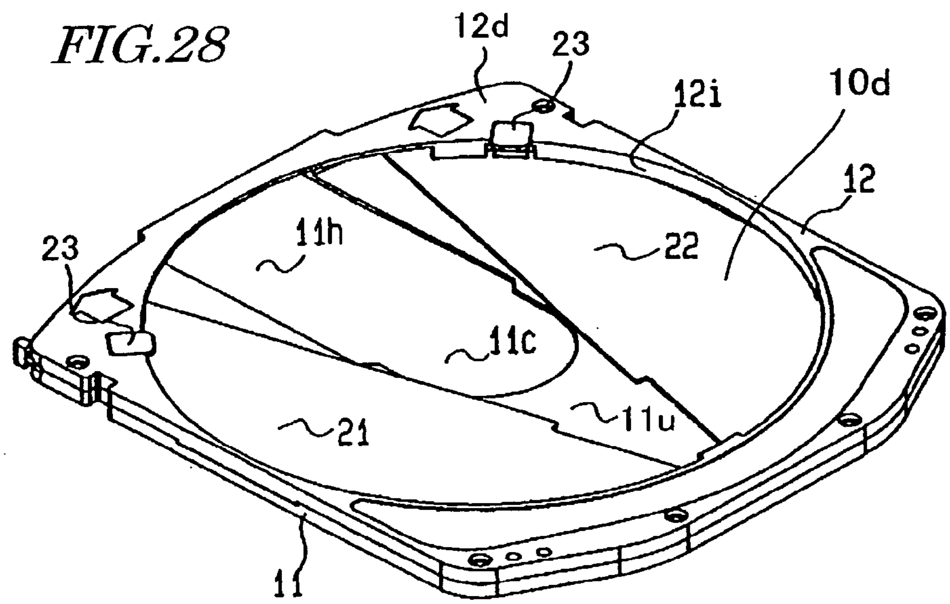

12d
23
12i
10d
12
23
11h
22
11c
11u
21
11

FIG.29

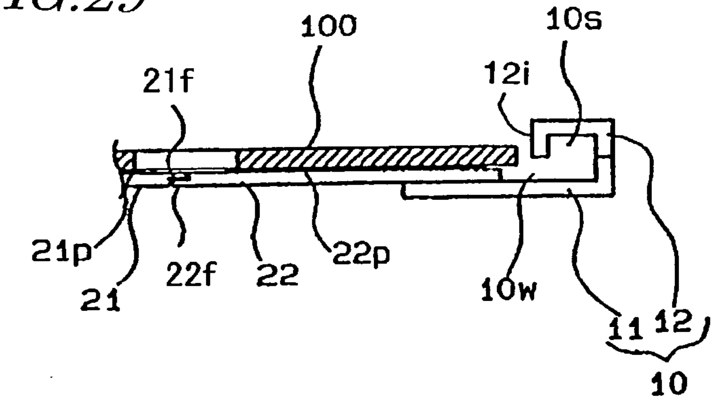


FIG.30

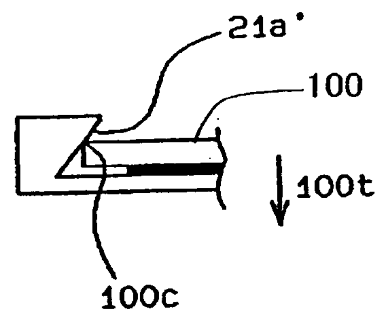


FIG.31

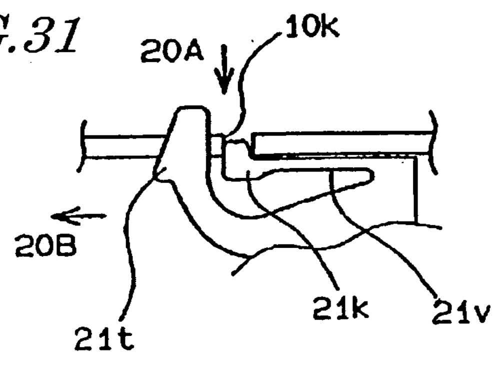


FIG.32

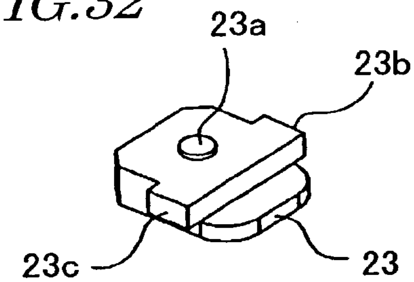


FIG.33

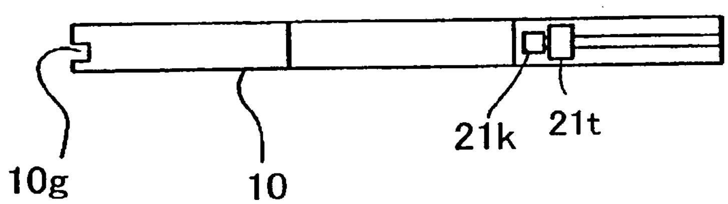


FIG. 34

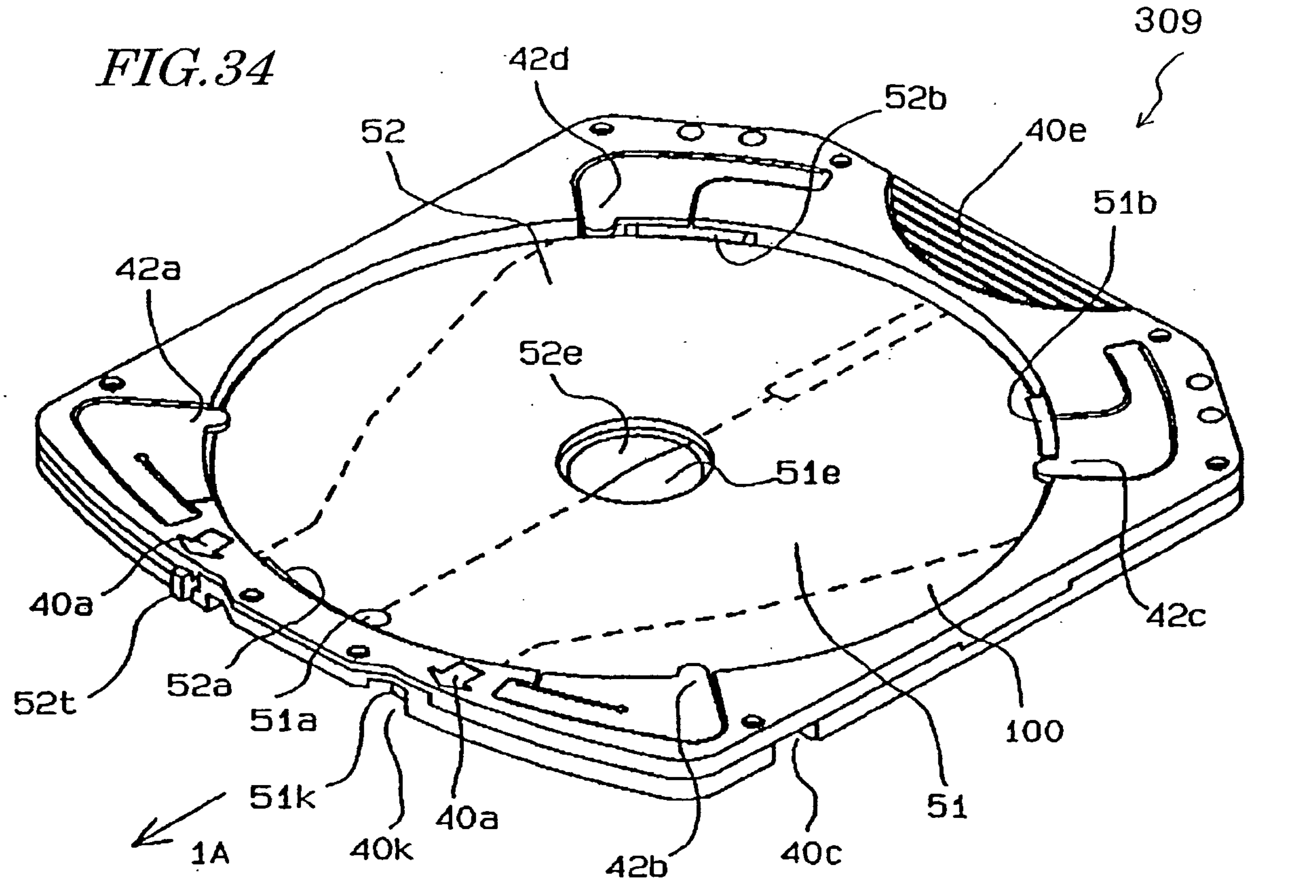

309
42d
52b
40e
52
51b
42a
52e
51e
40a
42c
52t
52a
51a
100
51k
40a
51
1A
40k
42b
40c

FIG.35

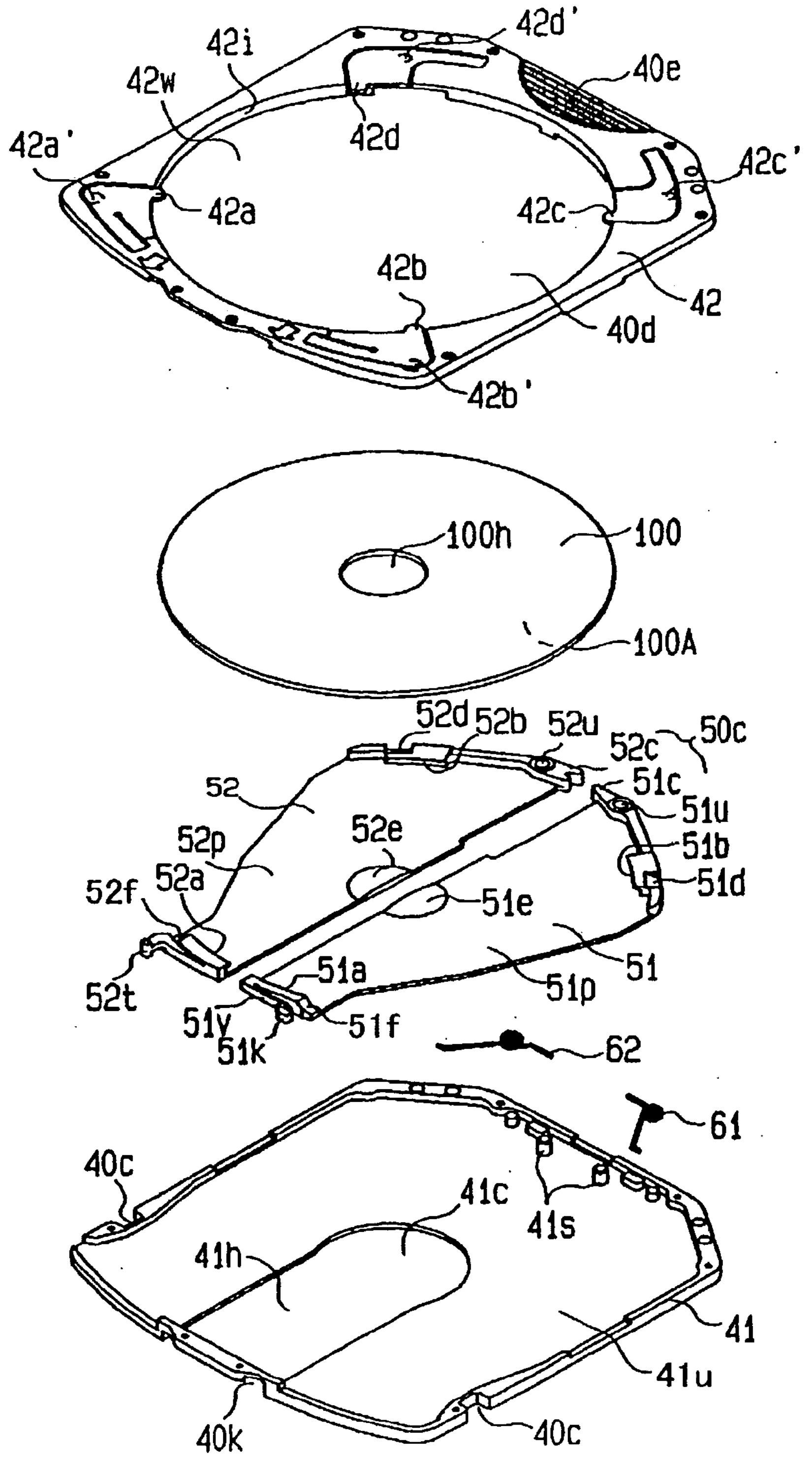

42d'
42i
40e
42w
42d
42a'
42c'
42a
42c
42b
42
40d
42b'
100h
100
100A
52d
52b
52u
52c
50c
52
51c
51u
52e
51b
52p
51d
52f
52a
51e
51
52t
51a
51p
51y
51k
51f
62
61
40c
41c
41s
41h
41
41u
40k
40c

FIG.36

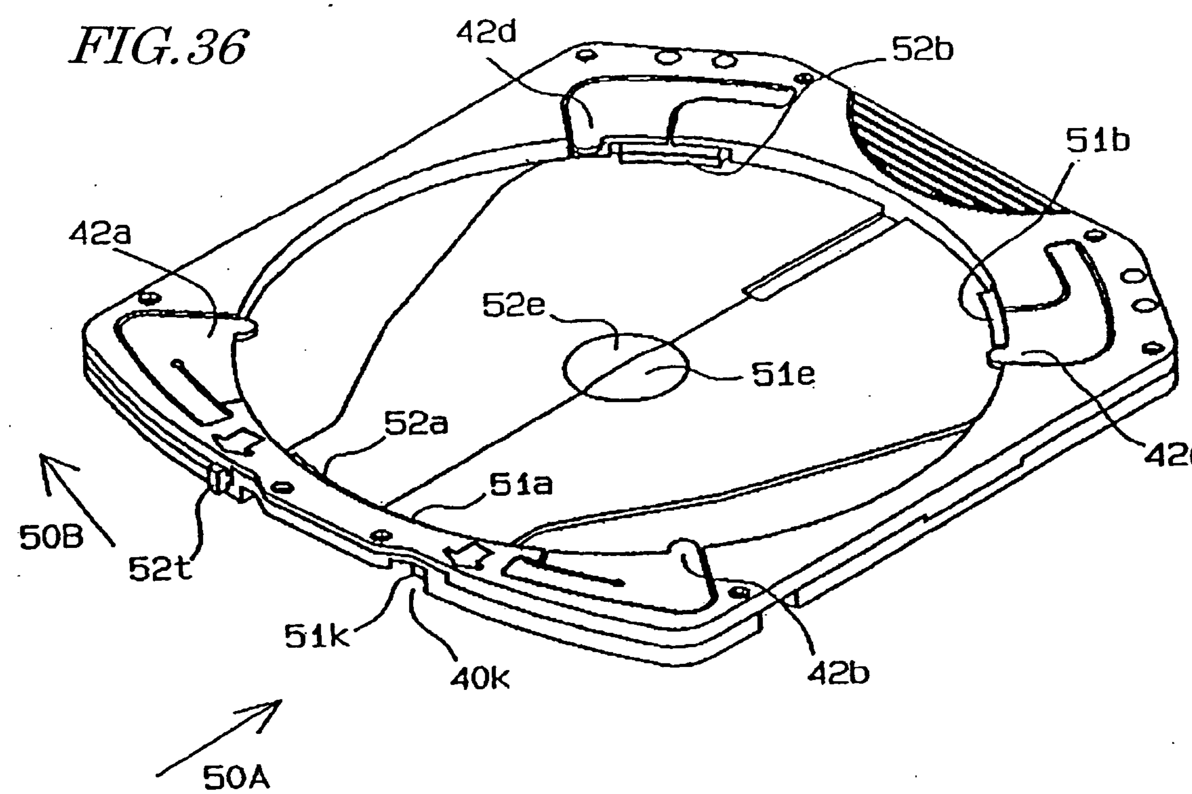

42d
52b
51b
42a
52e
51e
52a
42c
51a
50B
52t
51k
40k
42b
50A

FIG.37

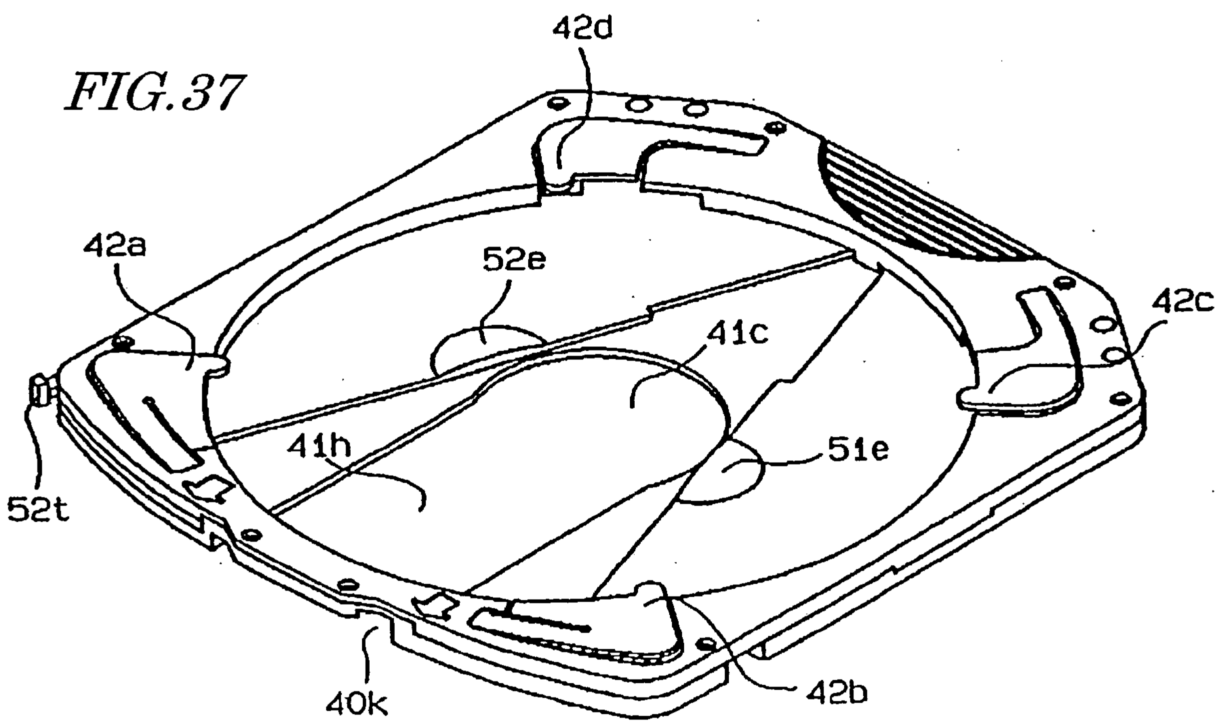

42d
42a
52e
42c
41c
41h
51e
52t
40k
42b

FIG.38

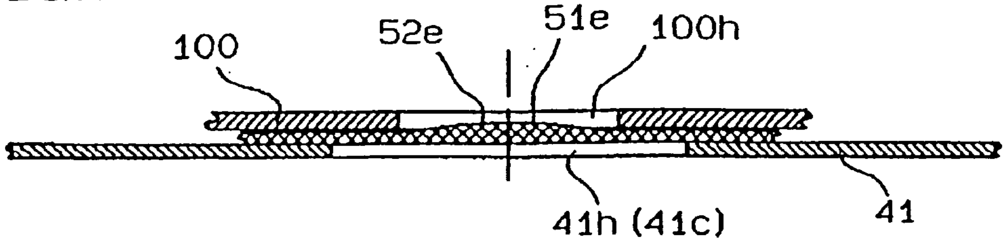


FIG.39

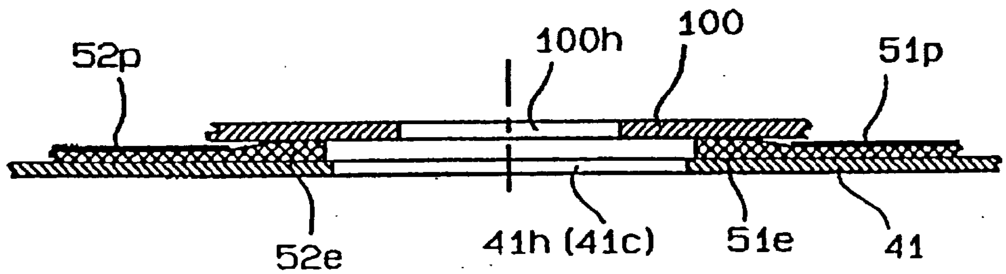


FIG.40

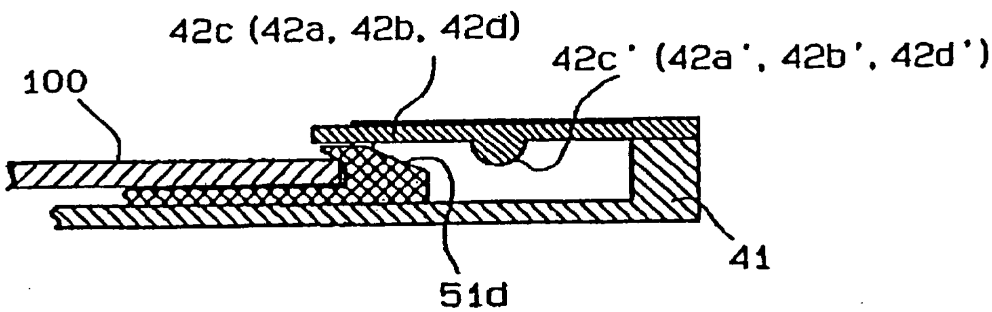


FIG.41

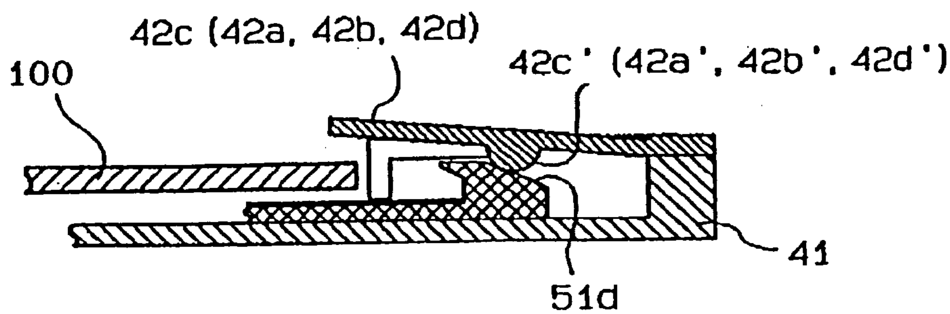


FIG.42

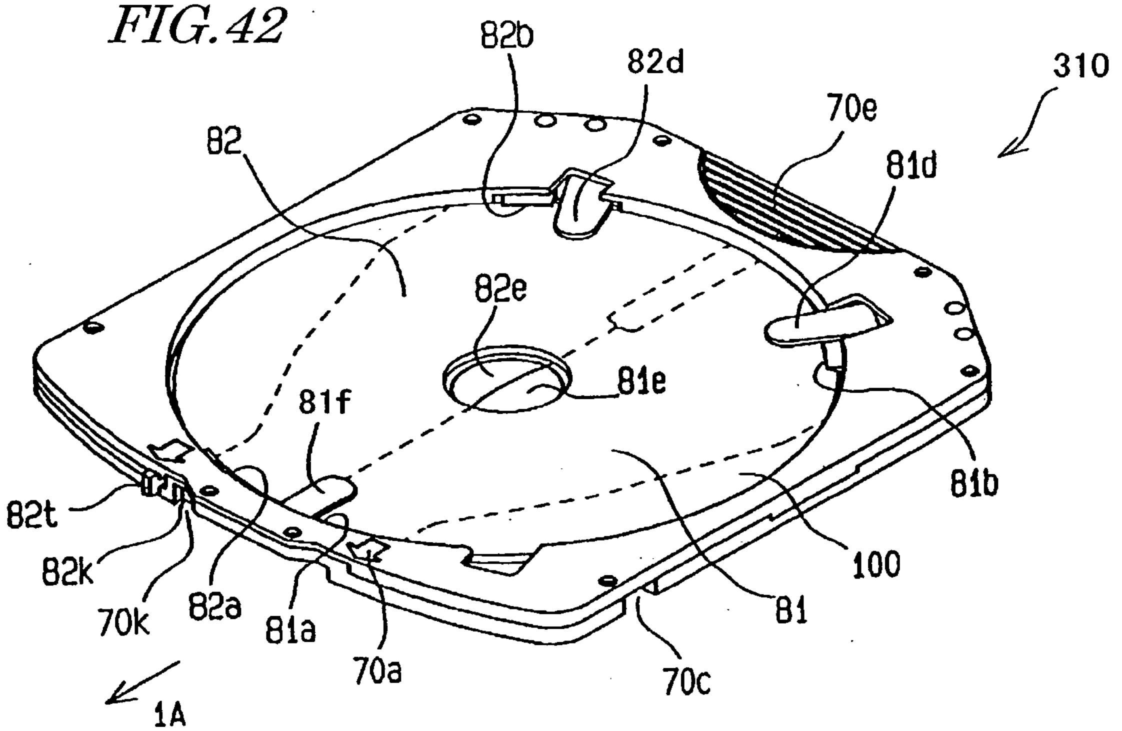

82b
82d
310
70e
82
81d
82e
81e
81f
81b
82t
100
82k
70k
82a
81a
70a
81
70c
1A

FIG.43

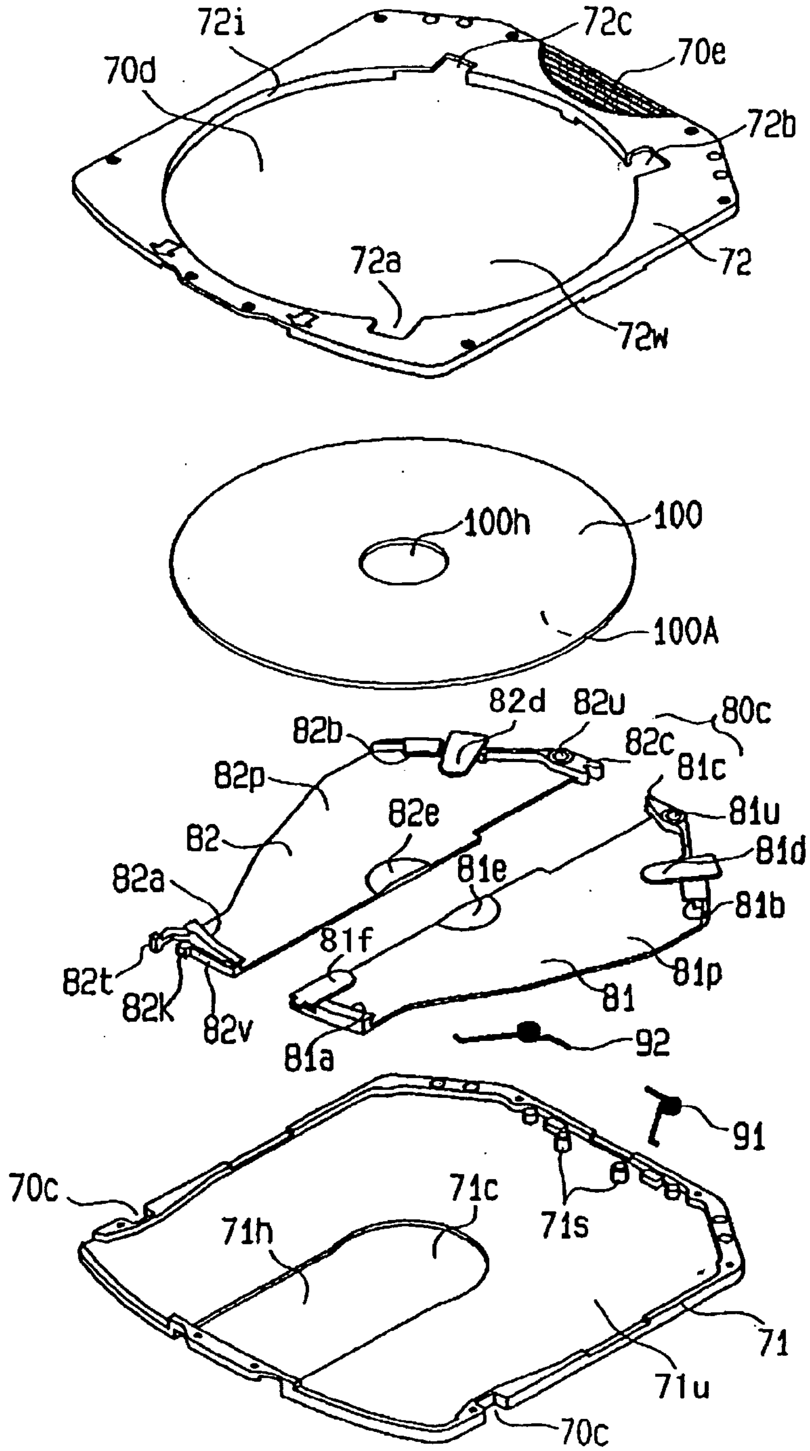

72i
72c
70e
70d
72b
72a
72
72w
100h
100
100A
82d
82u
80c
82b
82c
81c
82p
81u
82e
81d
82
81e
82a
81b
81f
81p
82t
81
82k
82v
81a
92
91
70c
71c
71h
71s
71
71u
70c

FIG. 44

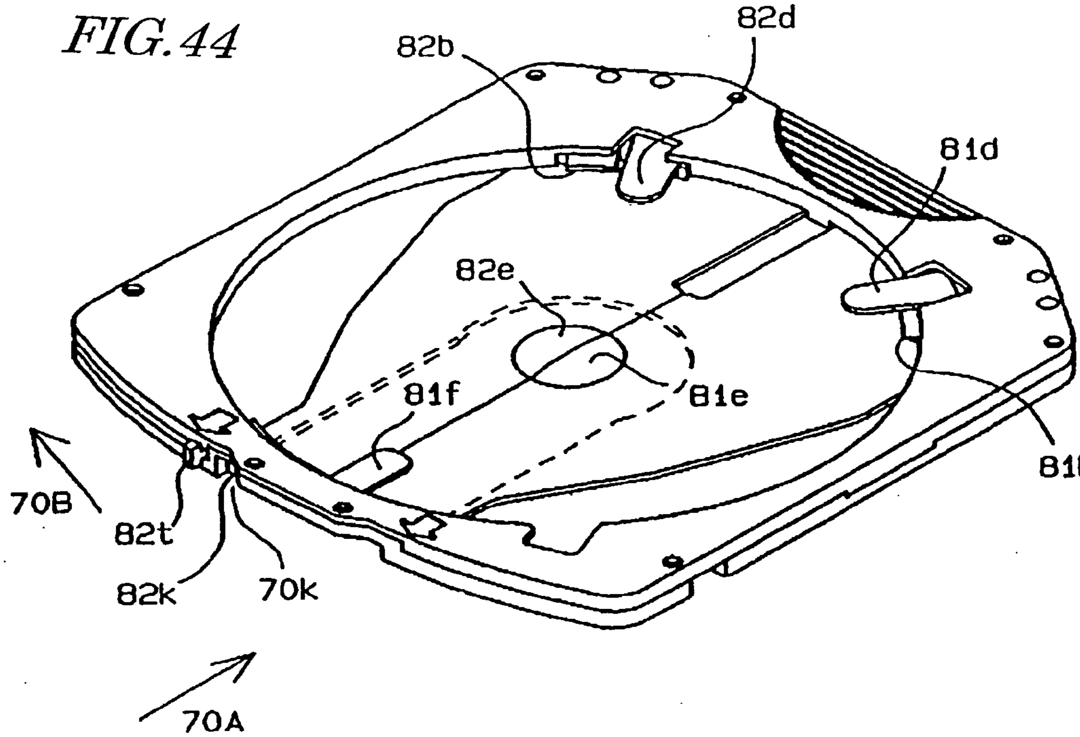

82d
82b
81d
82e
81e
81f
81b
70B
82t
82k
70k
70A

FIG. 45

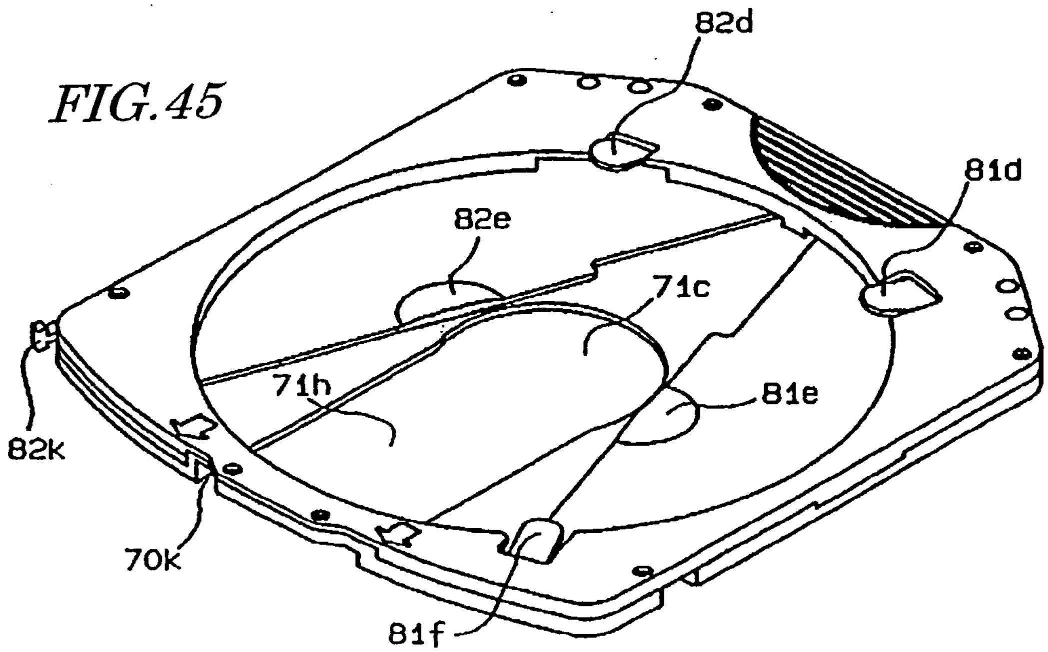

82d
81d
82e
71c
71h
81e
82k
70k
81f

FIG.46

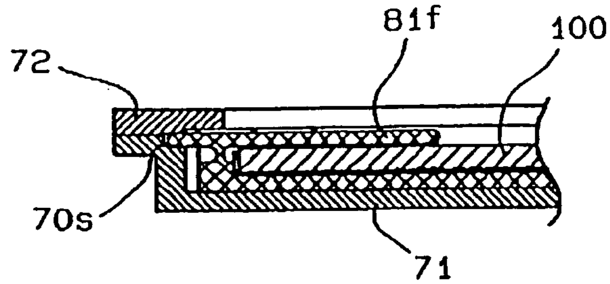


FIG.47

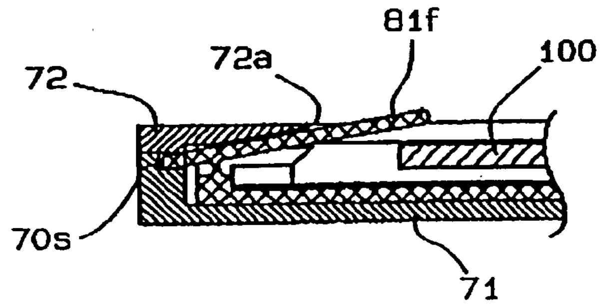


FIG.48

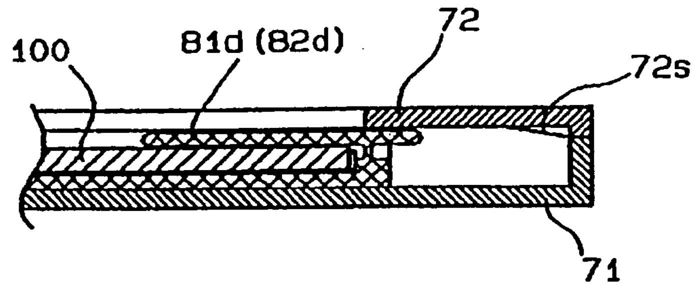


FIG.49

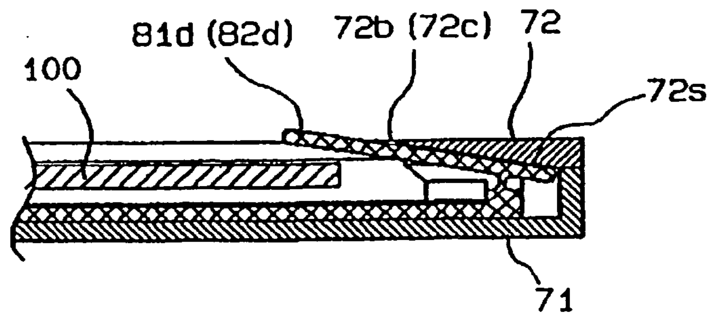


FIG.50

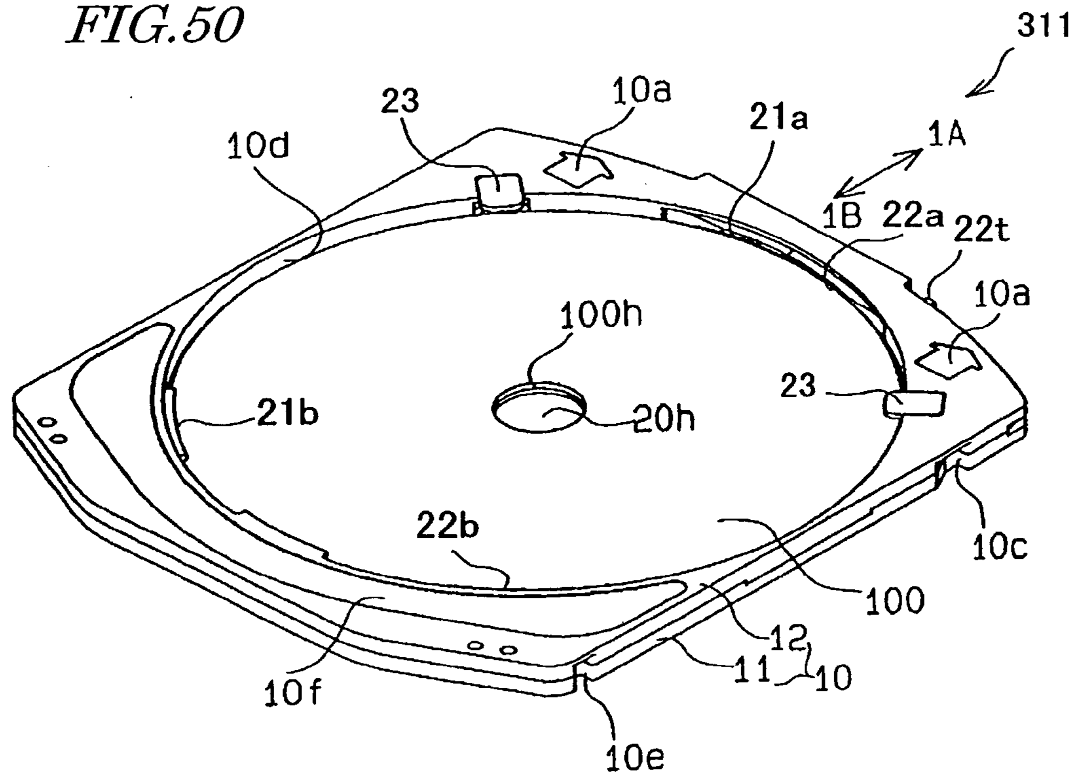
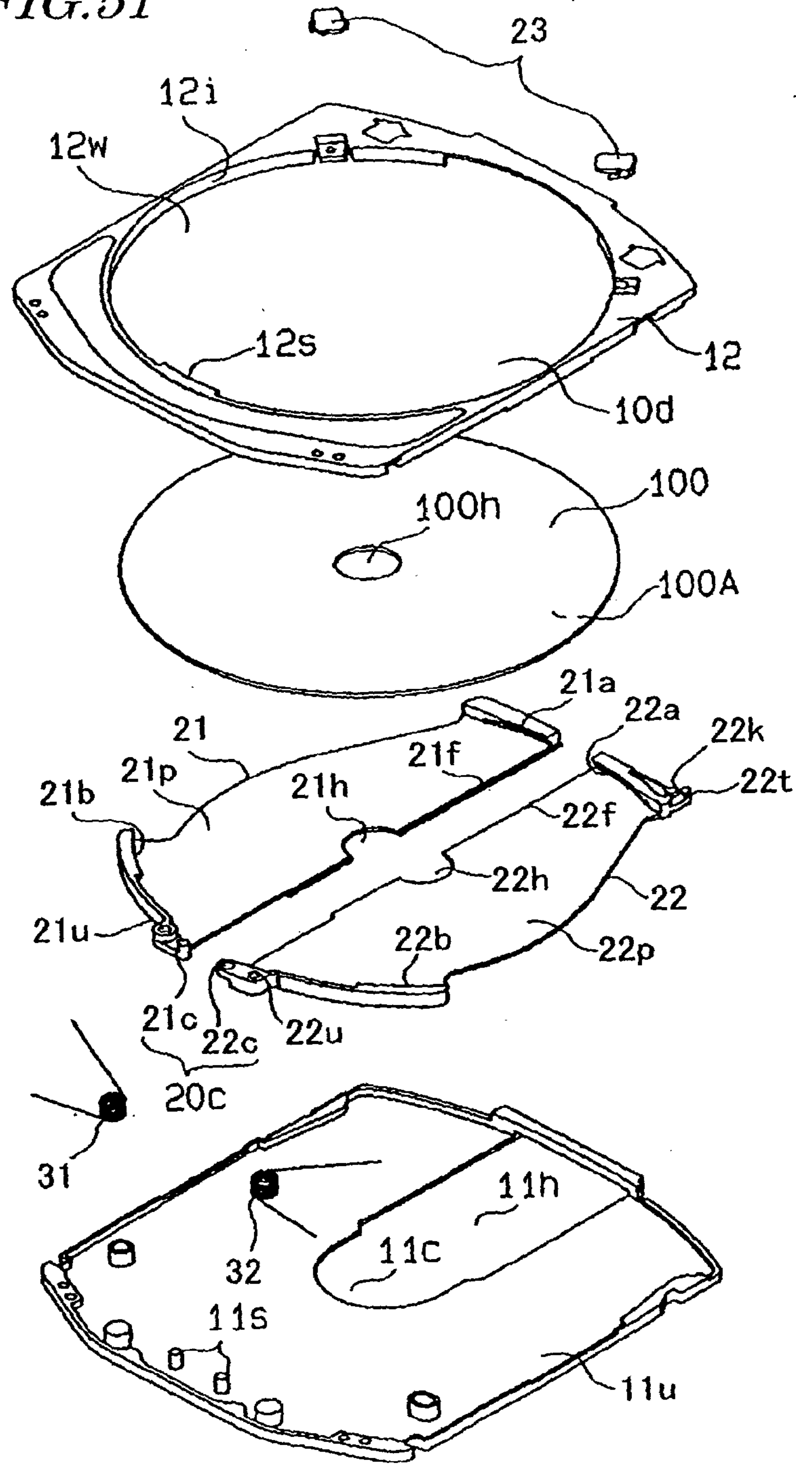

311
1A
1B
10a
23
21a
10d
22a
22t
10a
100h
23
21b
20h
22b
10c
100
12
10f
11
10
10e

FIG.51



23
12i
12W
12s
12
10d
100h
100
100A
21a
22a
22k
21
21f
21p
21b
21h
22t
22f
22h
22
21u
22b
22p
21c
22c
22u
20c
31
11h
32
11c
11s
11u

FIG.52

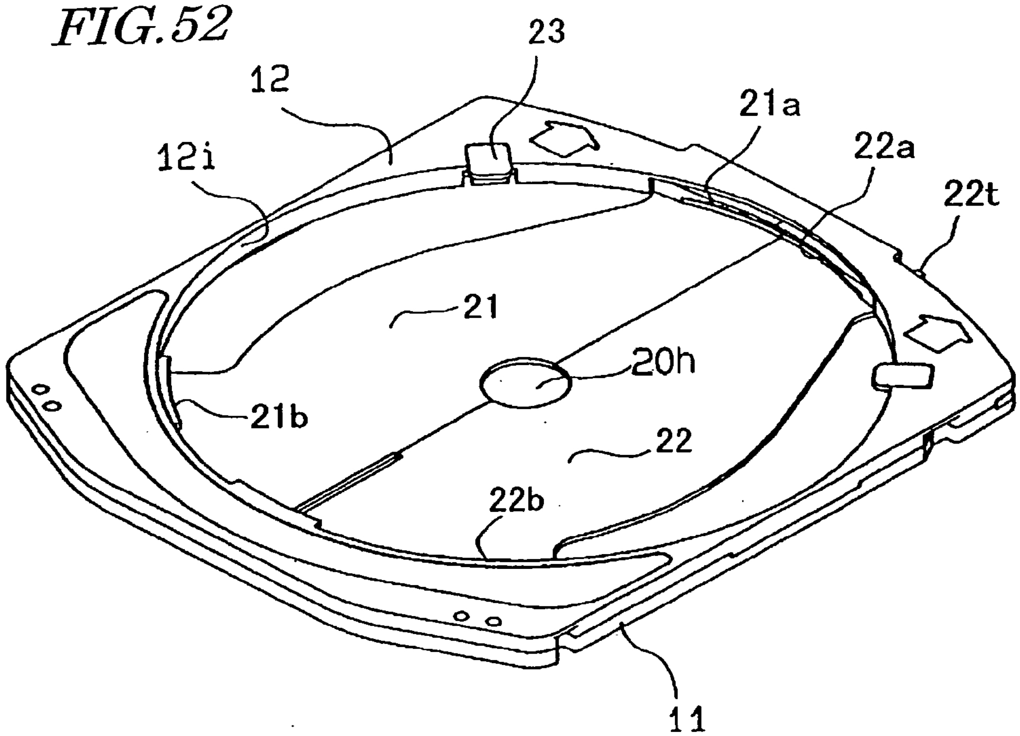

23
12
21a
12i
22a
22t
21
20h
21b
22
22b
11

FIG.53

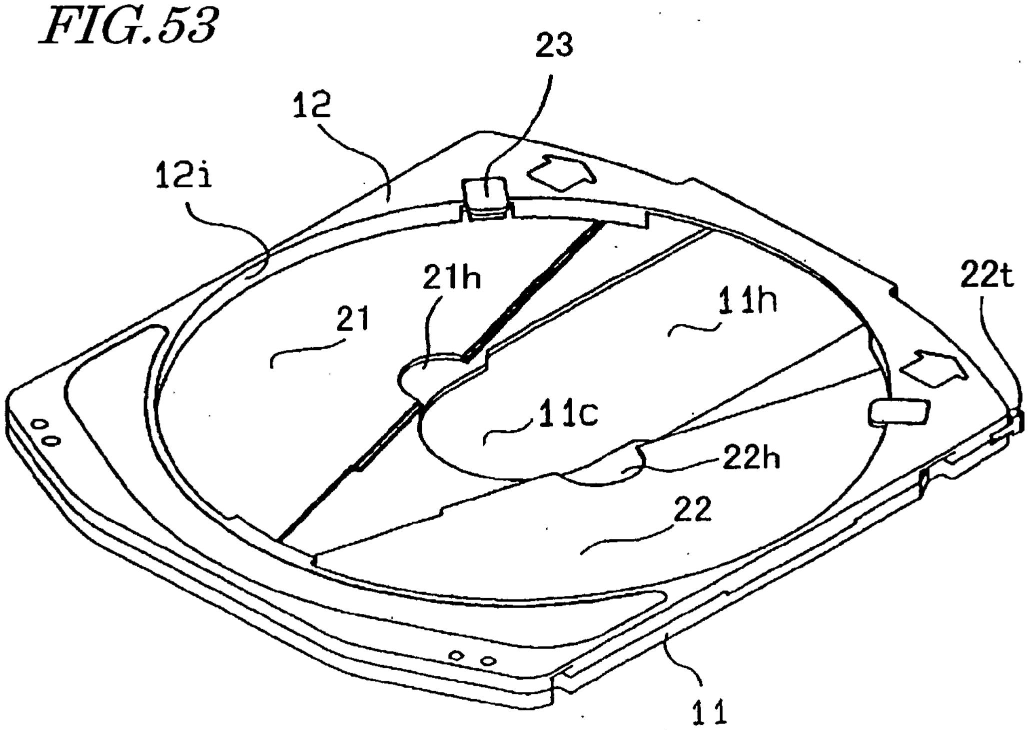

23
12
12i
22t
21h
11h
21
11c
22h
22
11

FIG.54

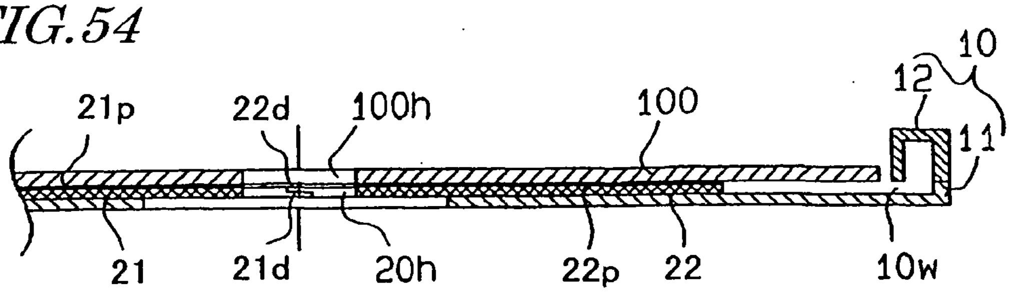


FIG.55

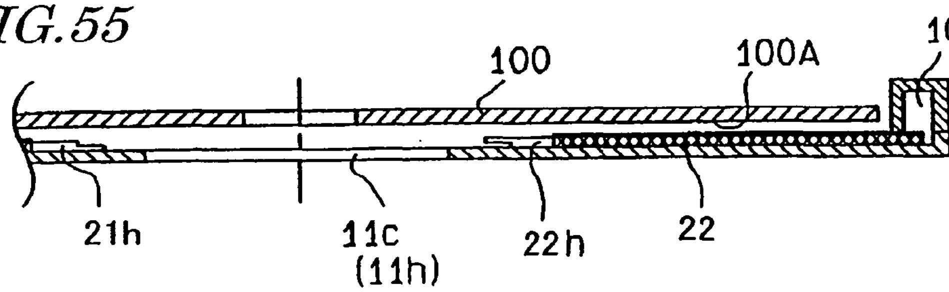


FIG.56

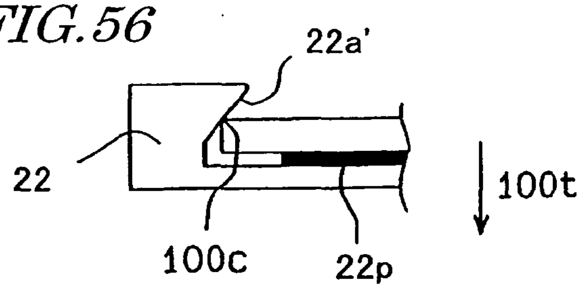


FIG.57

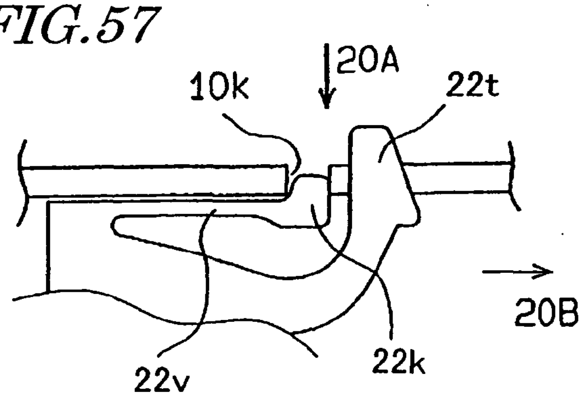


FIG.58

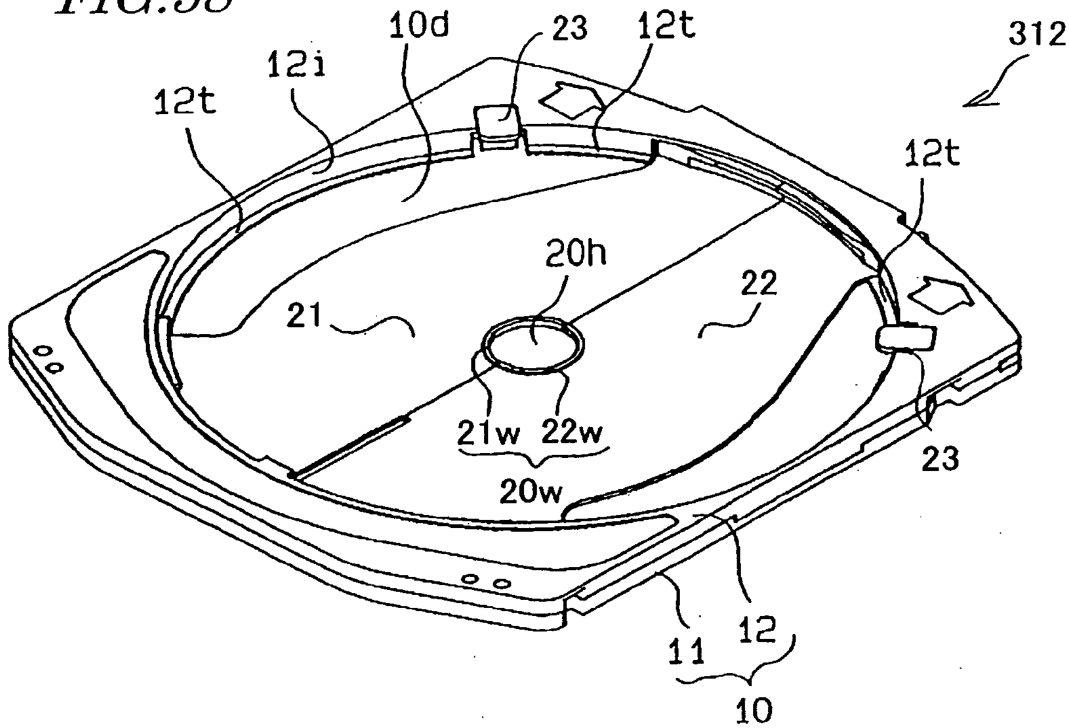

10d
23
12t
312
12i
12t
12t
20h
22
21
21w
22w
20w
23
11
12
10

FIG.59

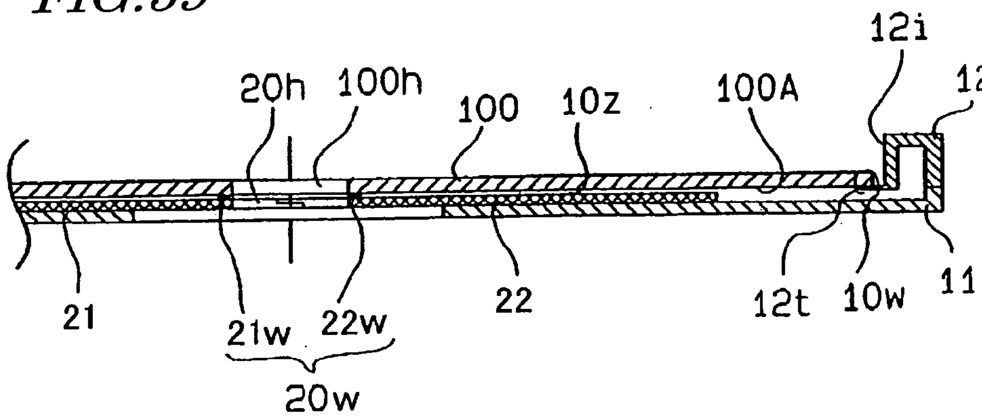

12i
20h
100h
100
10z
100A
12
21
21w
22w
20w
22
12t
10w
11

FIG.60

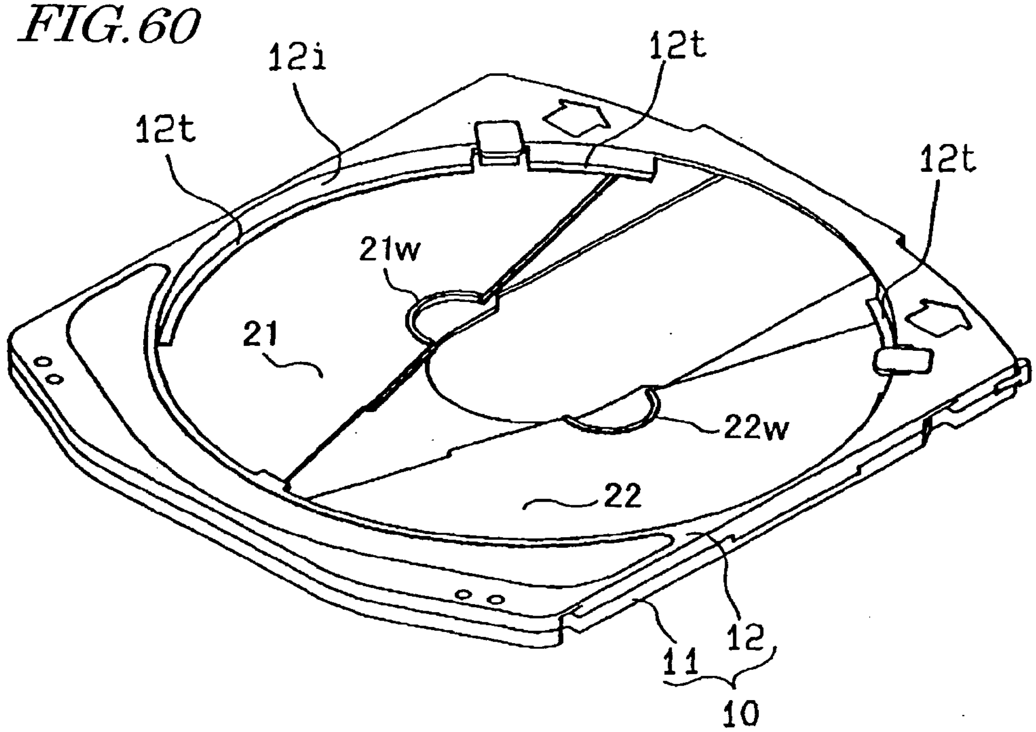


FIG.61

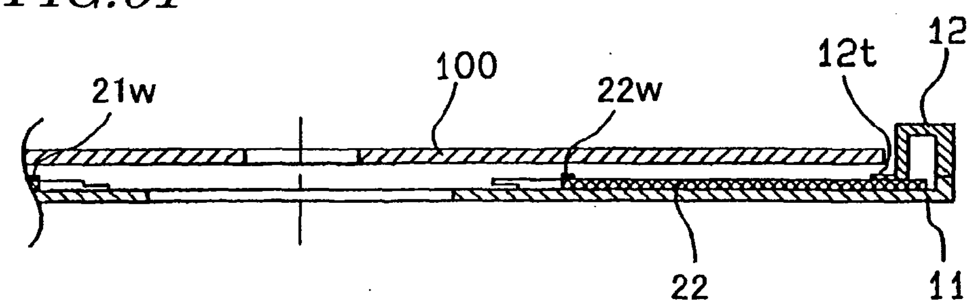


FIG.62

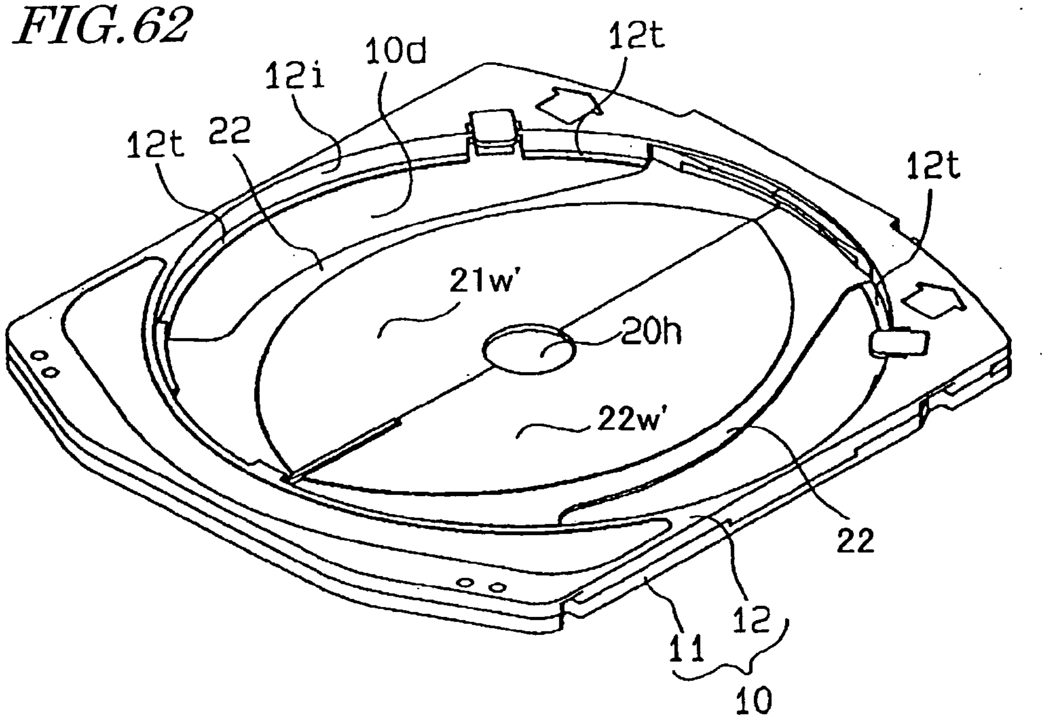

12t
10d
12i
12t
22
12t
21w'
20h
22w'
22
12
11
10

FIG.63

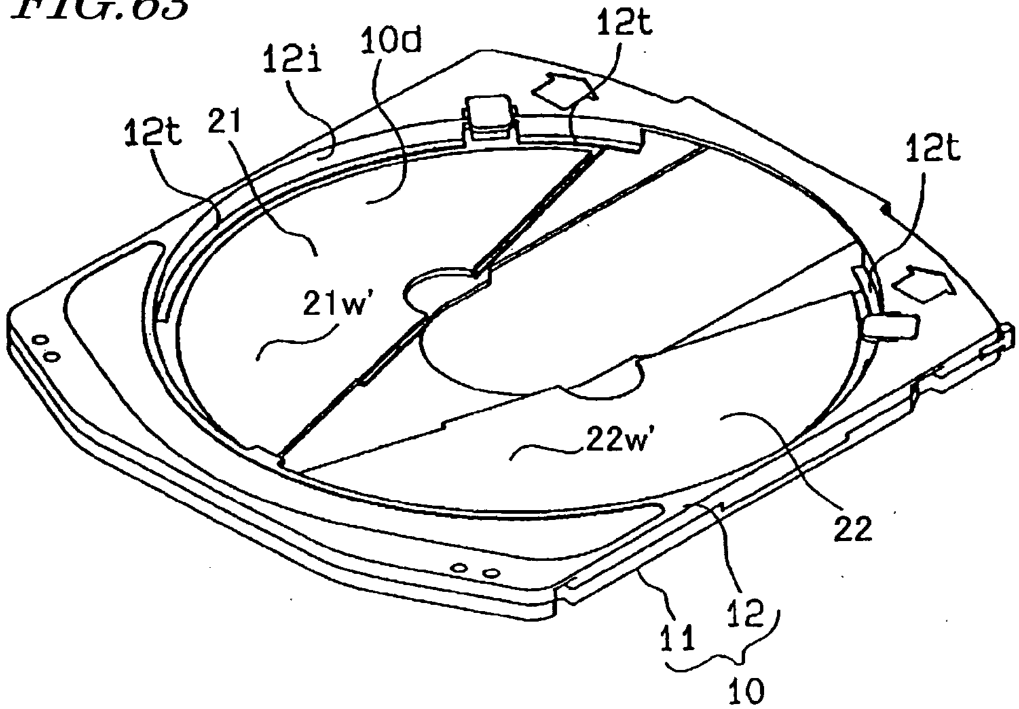

12t
10d
12i
12t
21
12t
21w'
22w'
22
12
11
10

FIG.64

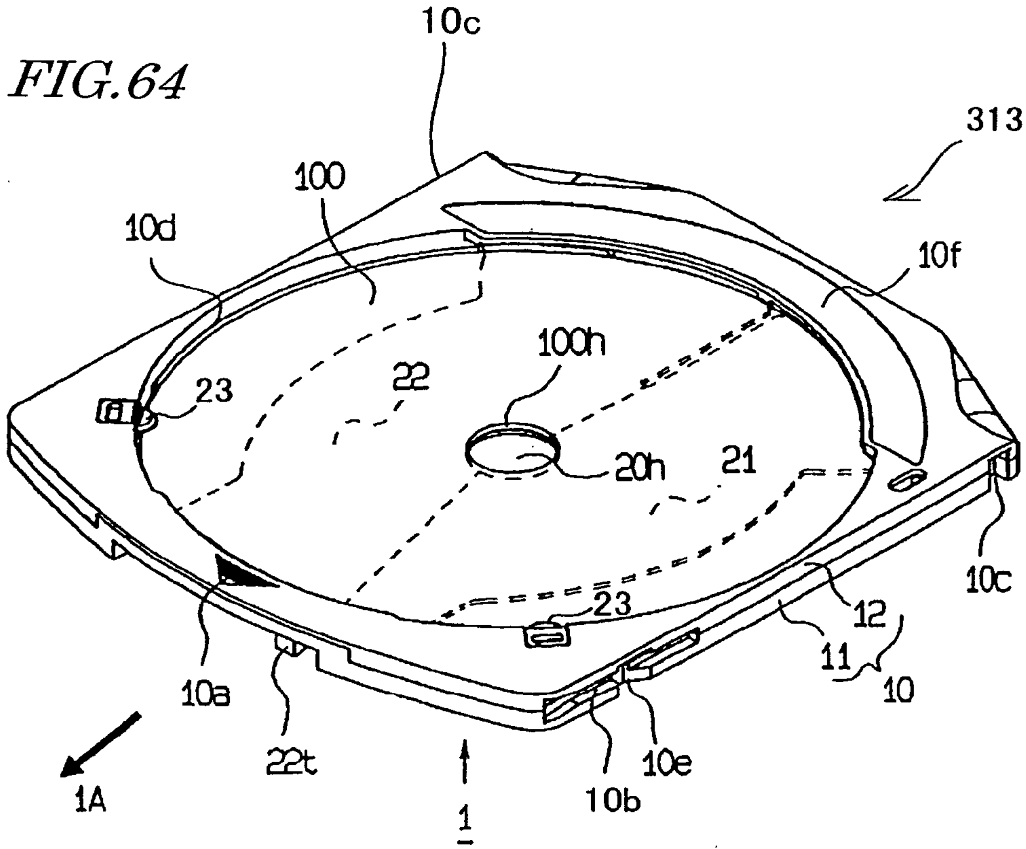

10c
313
100
10d
10f
100h
23
22
20h
21
10c
23
12
11
10
10a
22t
10e
1A
10b
1

FIG.65

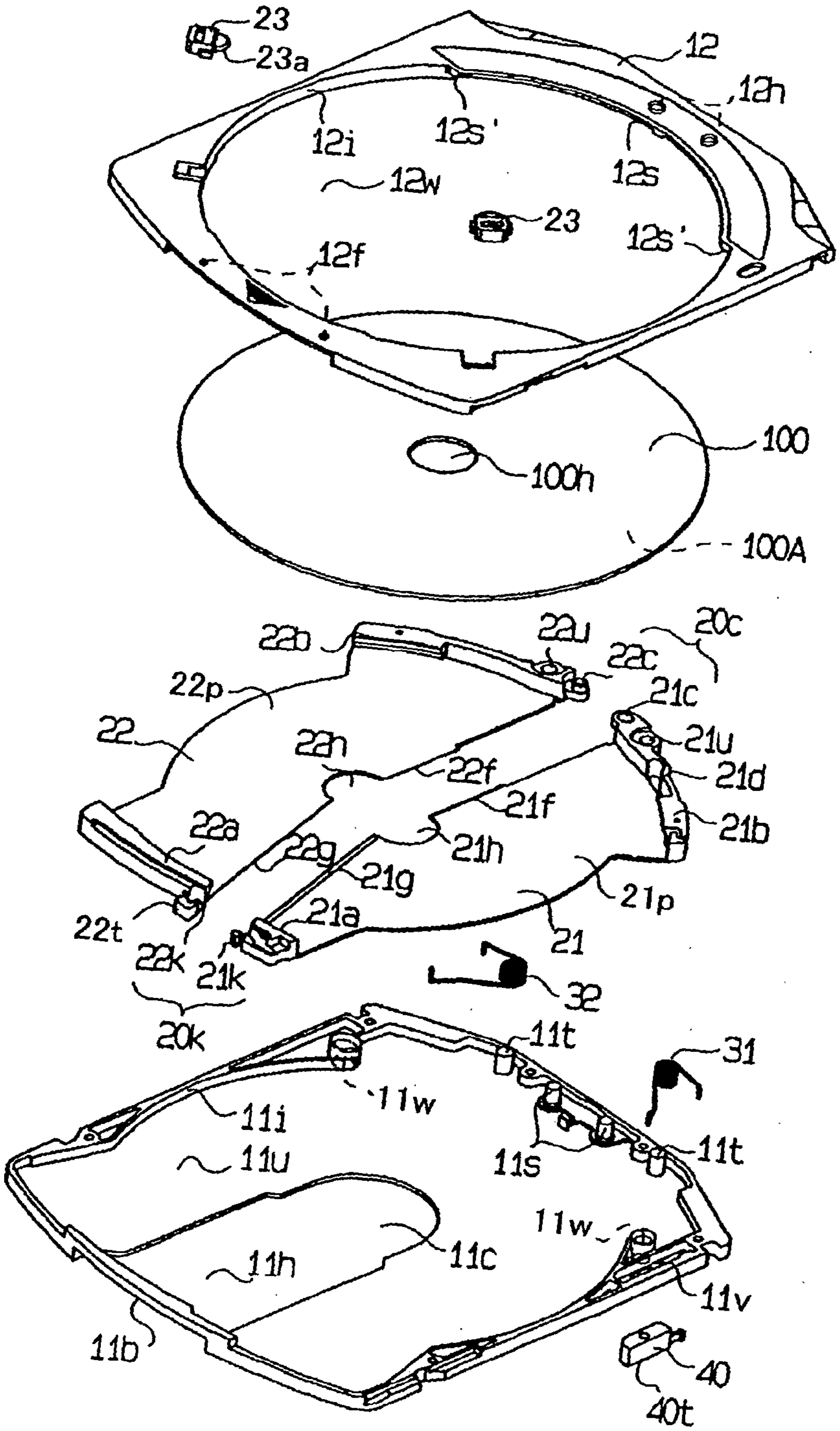

23
23a
12
12h
12i
12s'
12s
12w
23
12s'
12f
100
100h
100A
22b
22u
22c
20c
22p
21c
22
22h
21u
22f
21d
21f
21b
22a
22g
21h
21g
21p
22t
21a
21
22k
21k
32
20k
11t
31
11w
11i
11u
11s
11t
11w
11h
11c
11v
11b
40
40t

FIG. 66

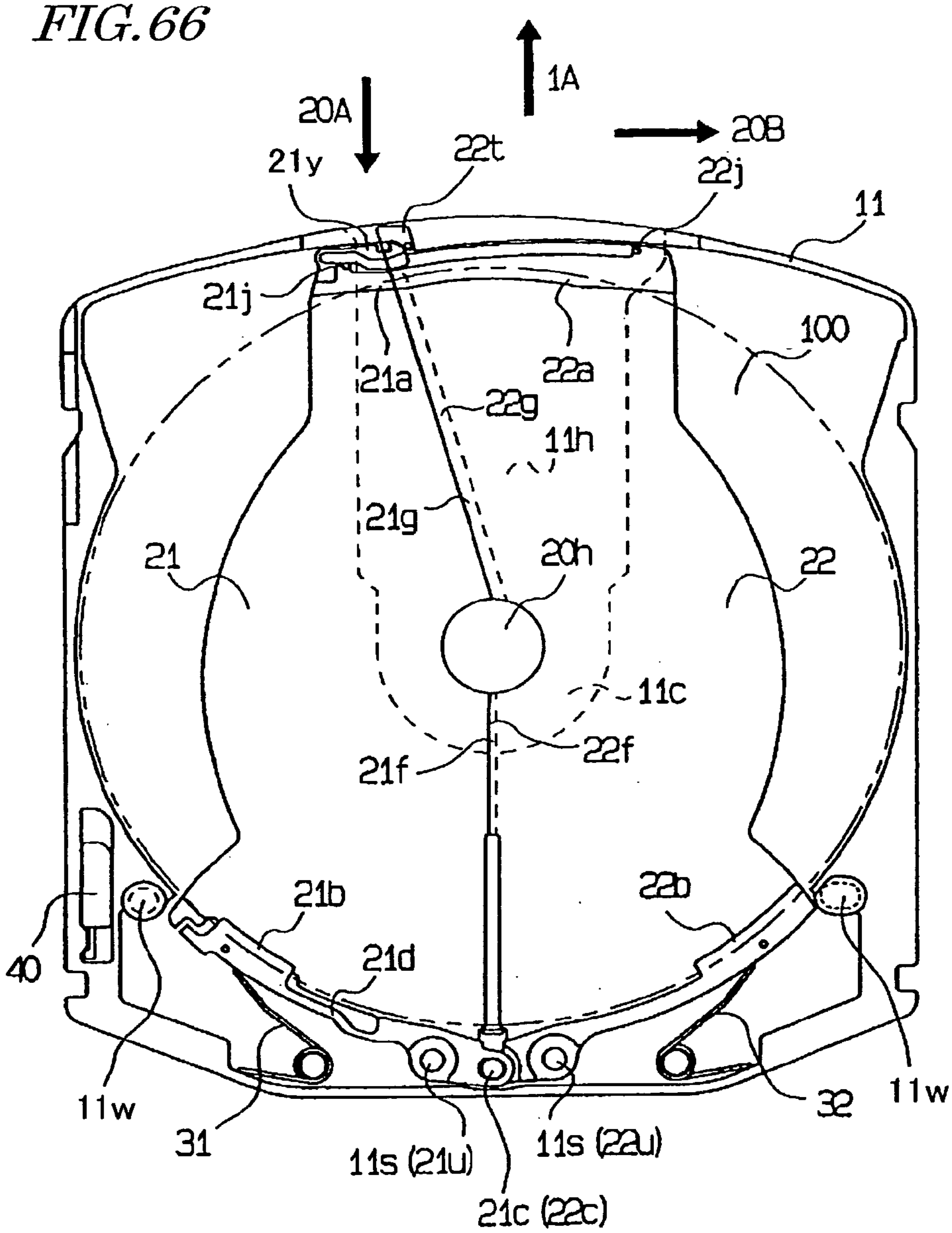

1A
20A
20B
21y
22t
22j
11
21j
21a
22a
100
22g
11h
21g
21
20h
22
11c
21f
22f
21b
22b
40
21d
11w
31
11s (21u)
11s (22u)
21c (22c)
32
11w

FIG.67

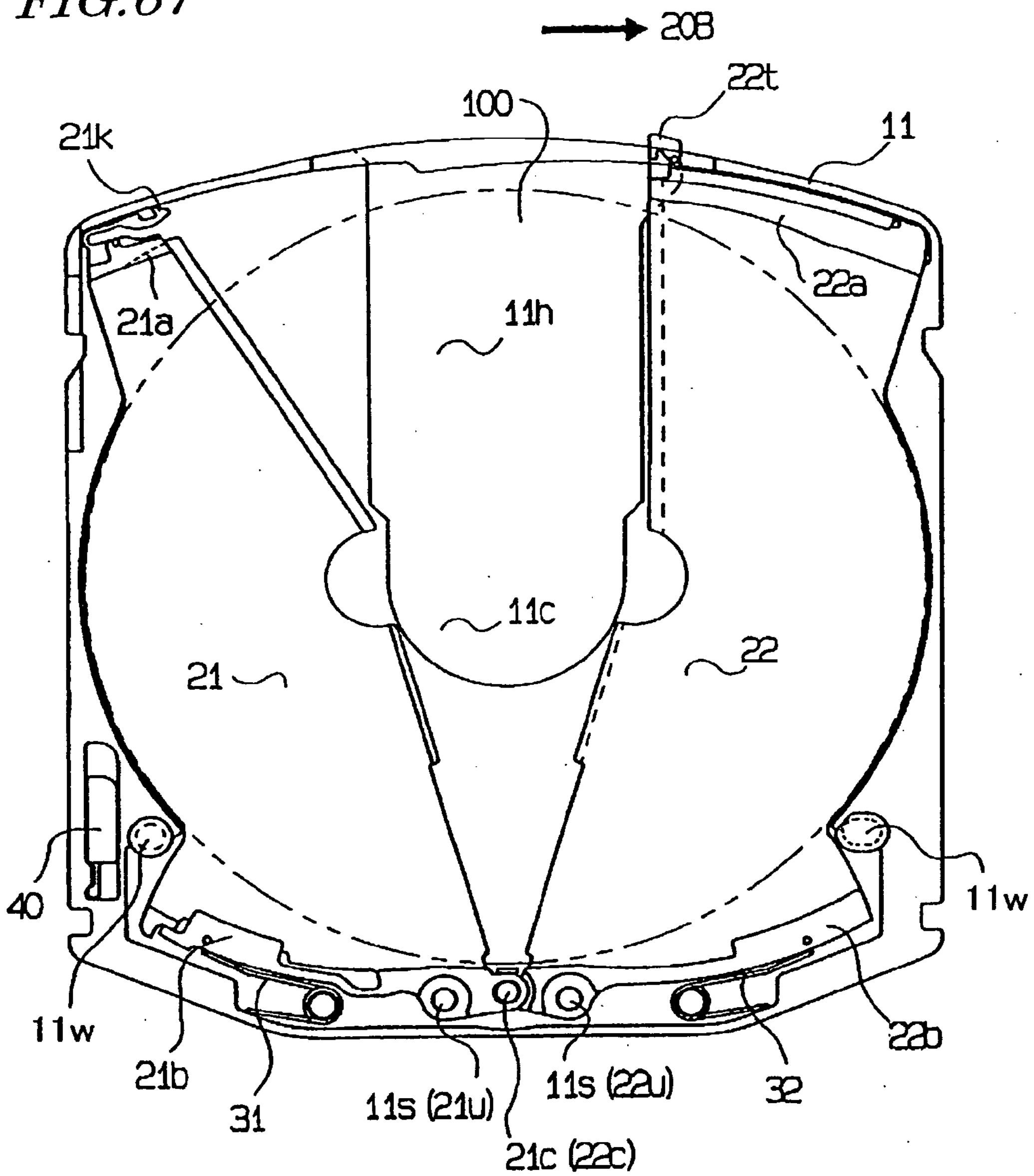

208
22t
100
11
21k
22a
21a
11h
11c
22
21
40
11w
11w
22b
21b
32
11s (22u)
31
11s (21u)
21c (22c)

FIG.68

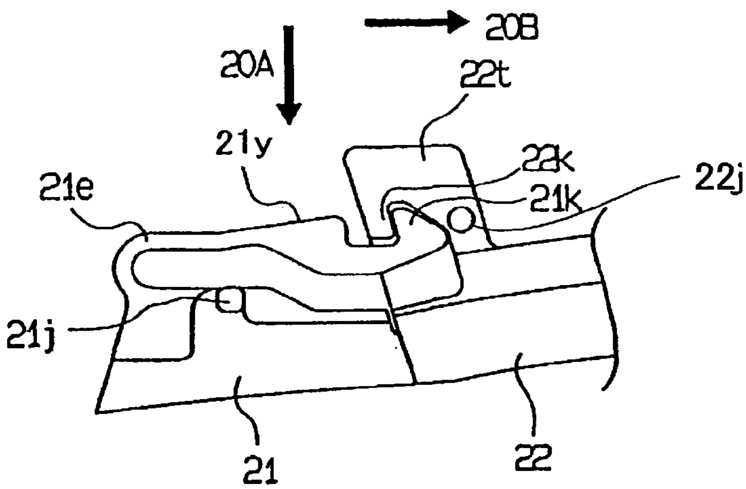

20A
20B
22t
21y
22k
21e
21k
22j
21j
21
22

FIG.69

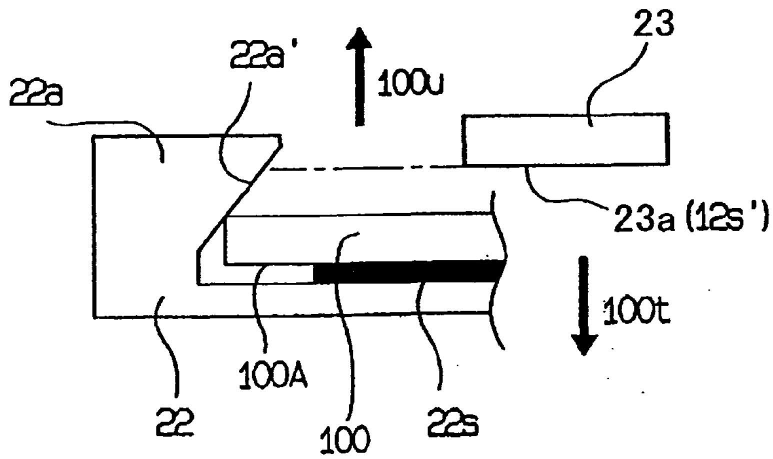

23
22a'
100u
22a
23a (12s')
100t
100A
22
100
22s

FIG. 70

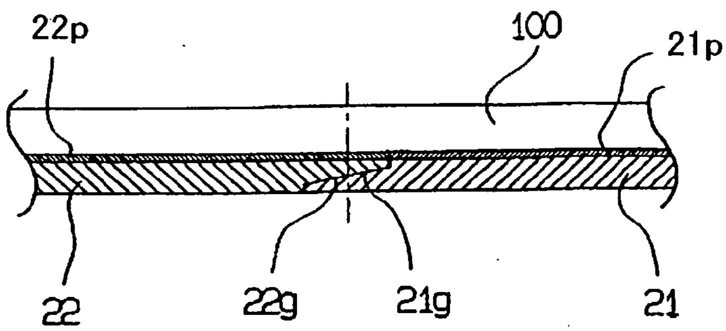


FIG. 71

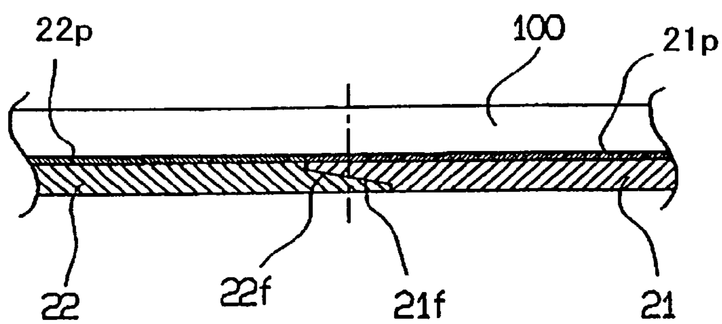


FIG. 72

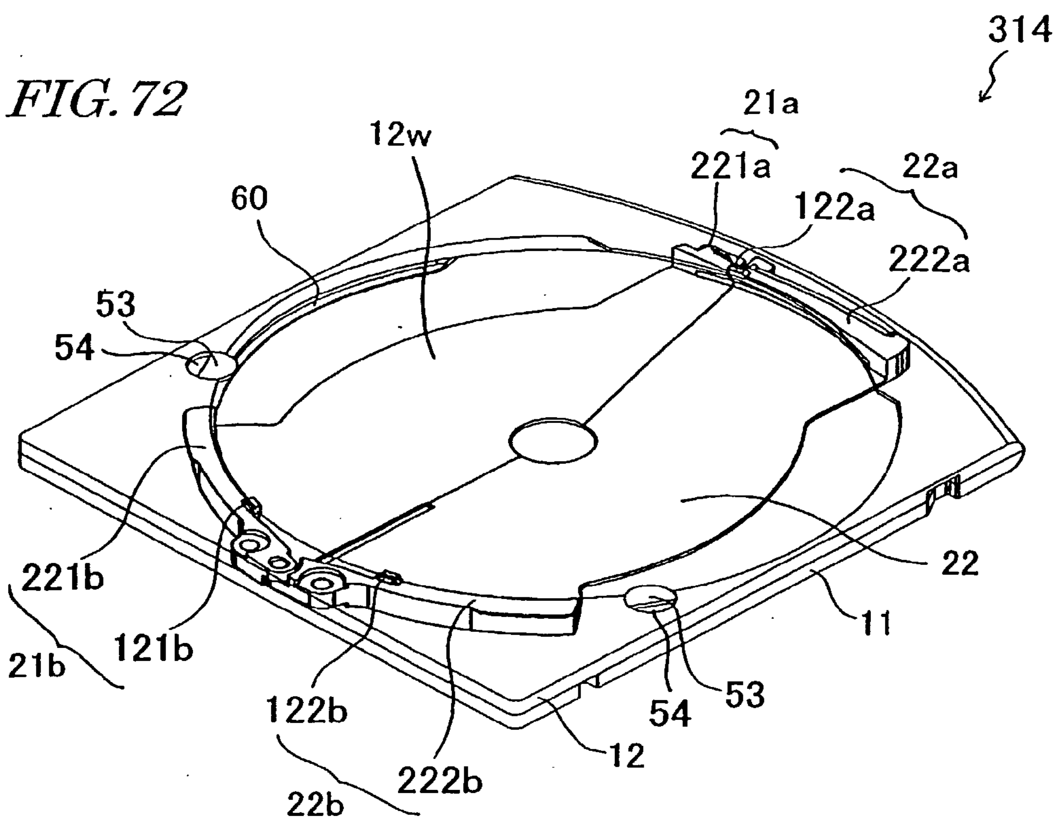

314
21a
221a
22a
122a
222a
12w
60
53
54
221b
21b
121b
122b
22b
222b
12
54
53
11
22

FIG. 73

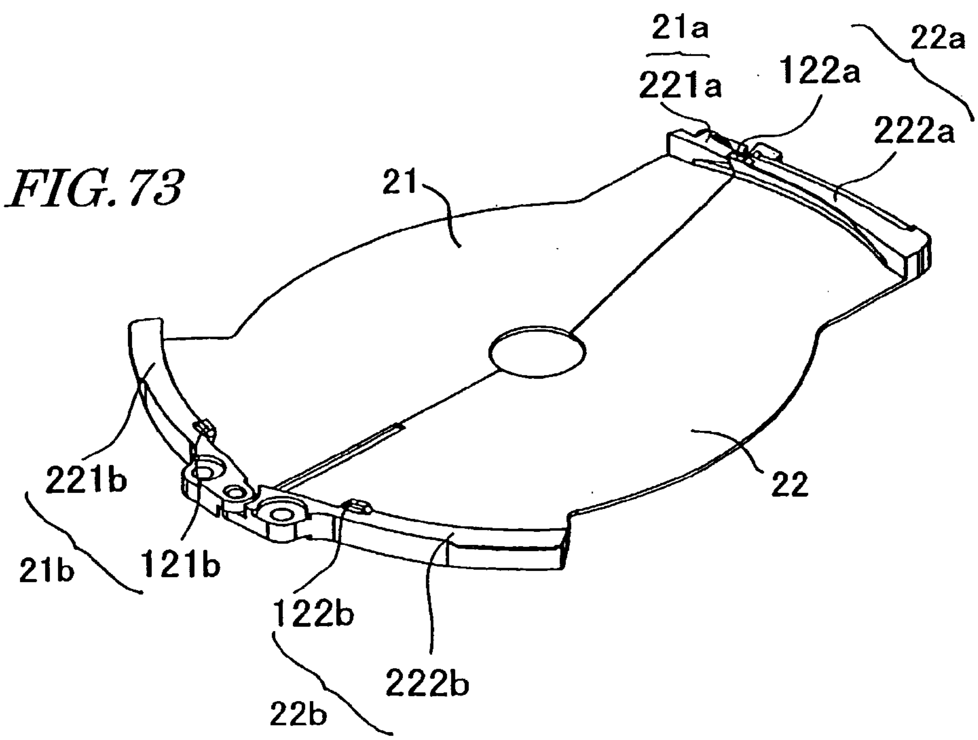

21a
221a
22a
122a
222a
21
221b
21b
121b
122b
22b
222b
22

FIG. 74

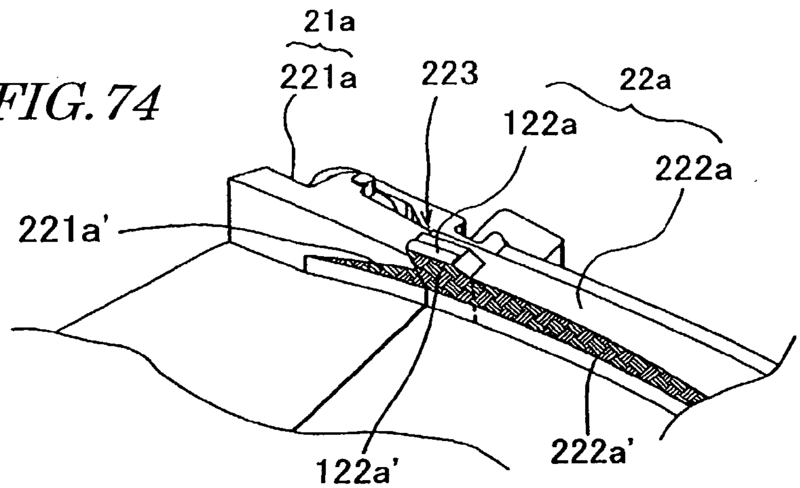


FIG. 75

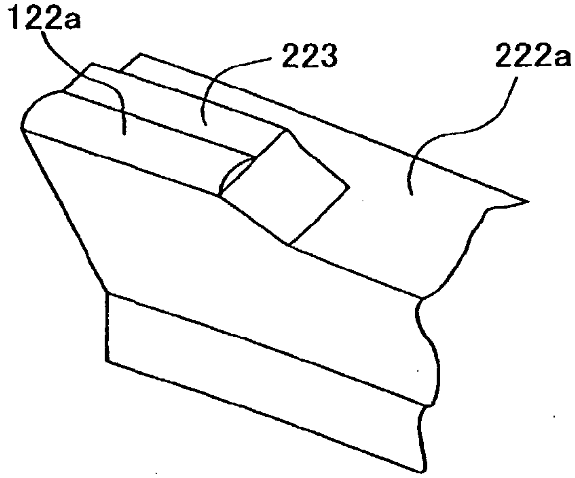


FIG. 76

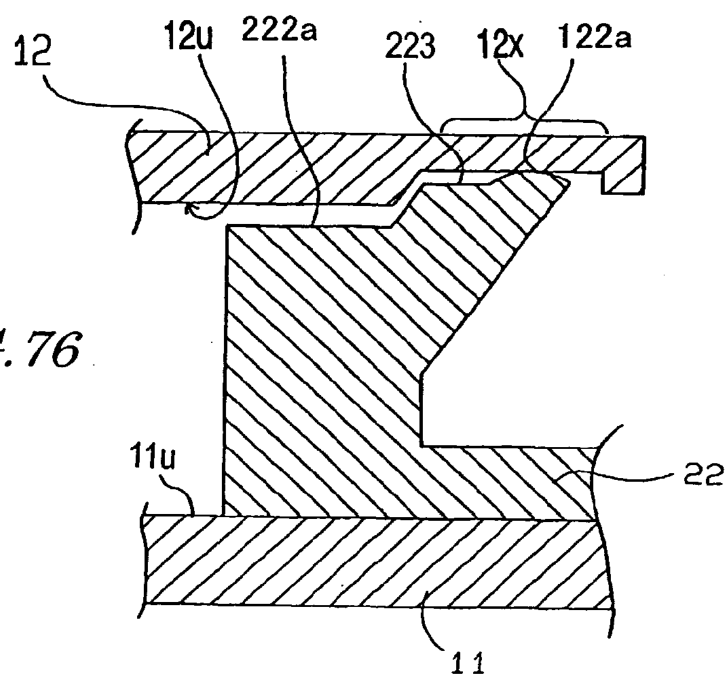


FIG. 77

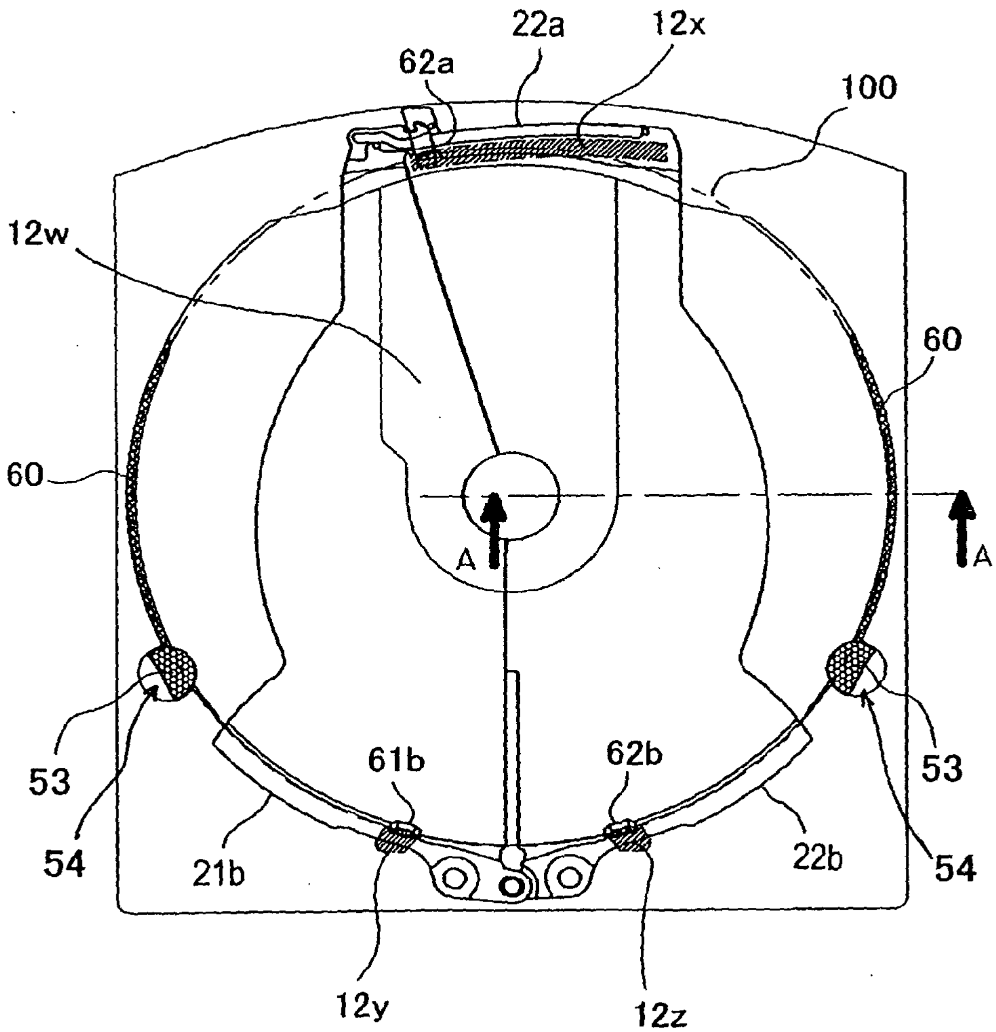


FIG. 78

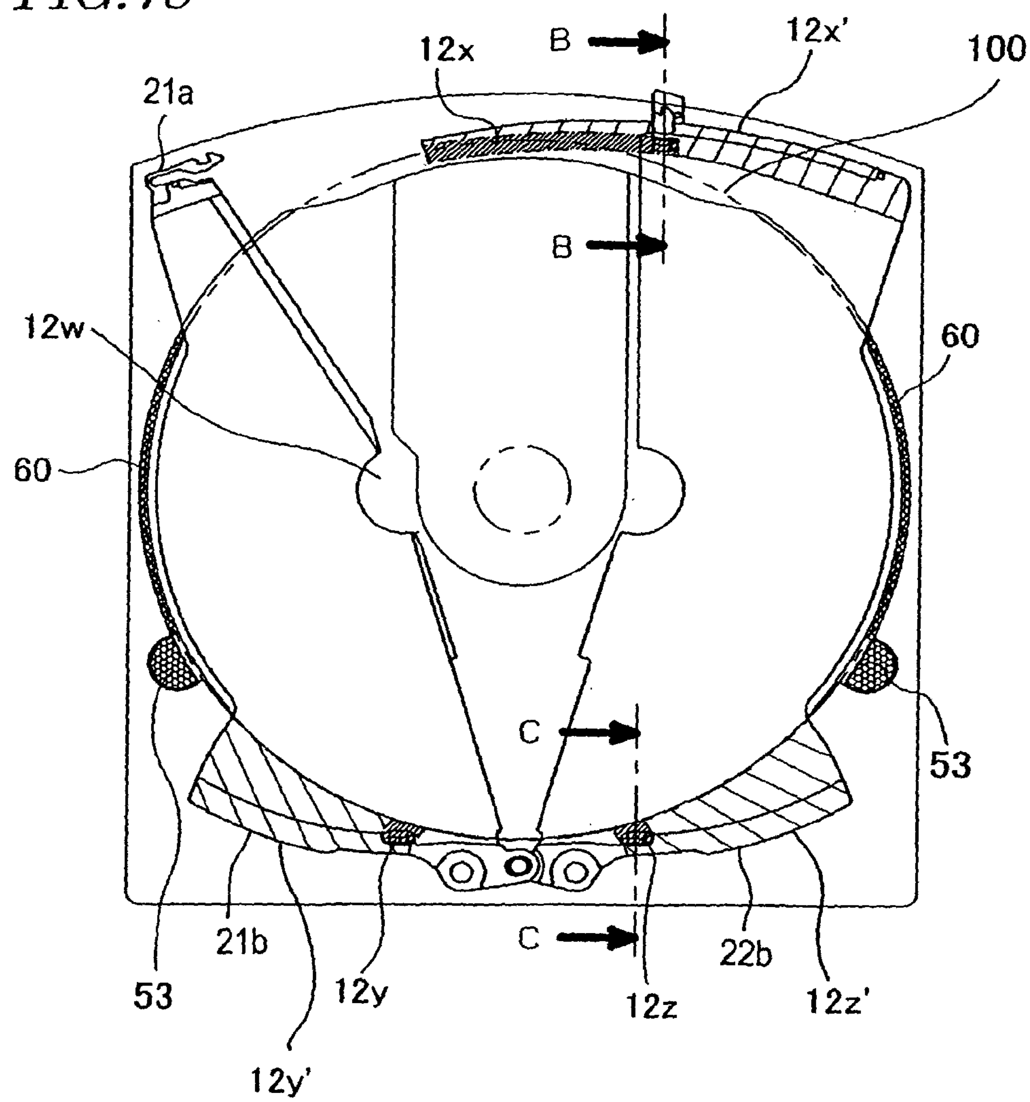


FIG. 79

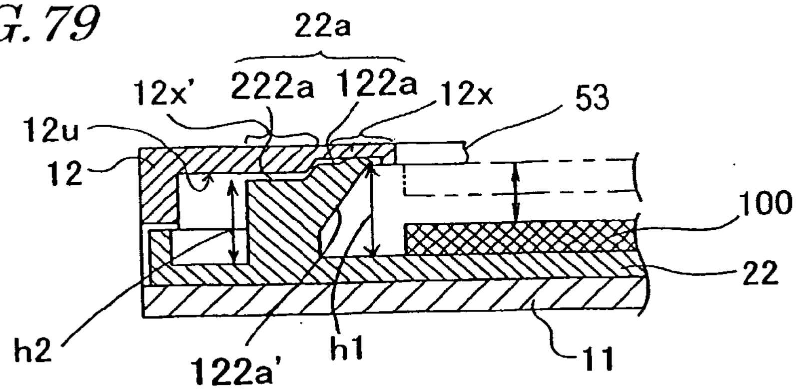


FIG. 80

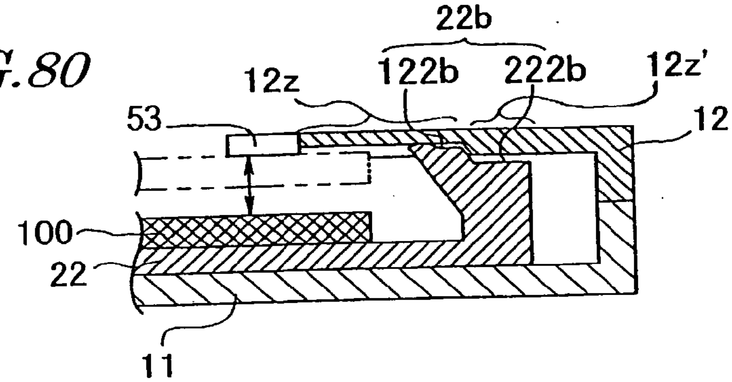


FIG. 81

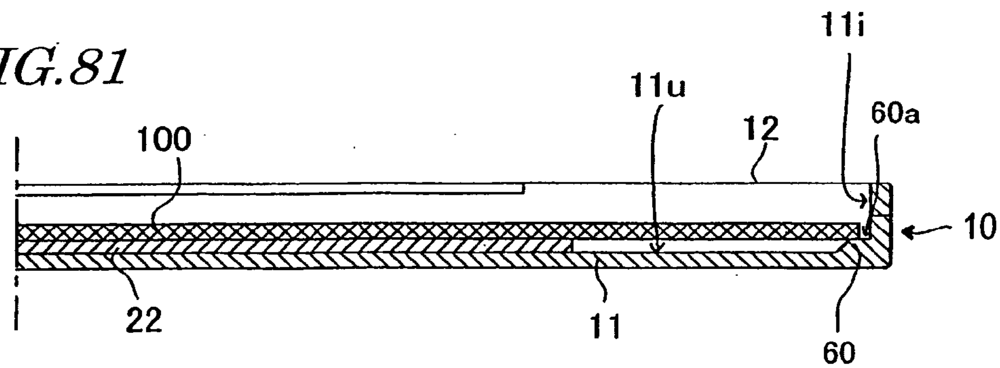


FIG. 82

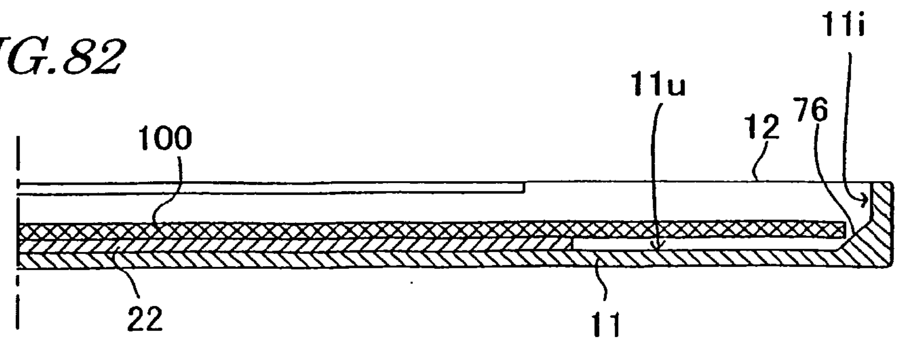


FIG.83

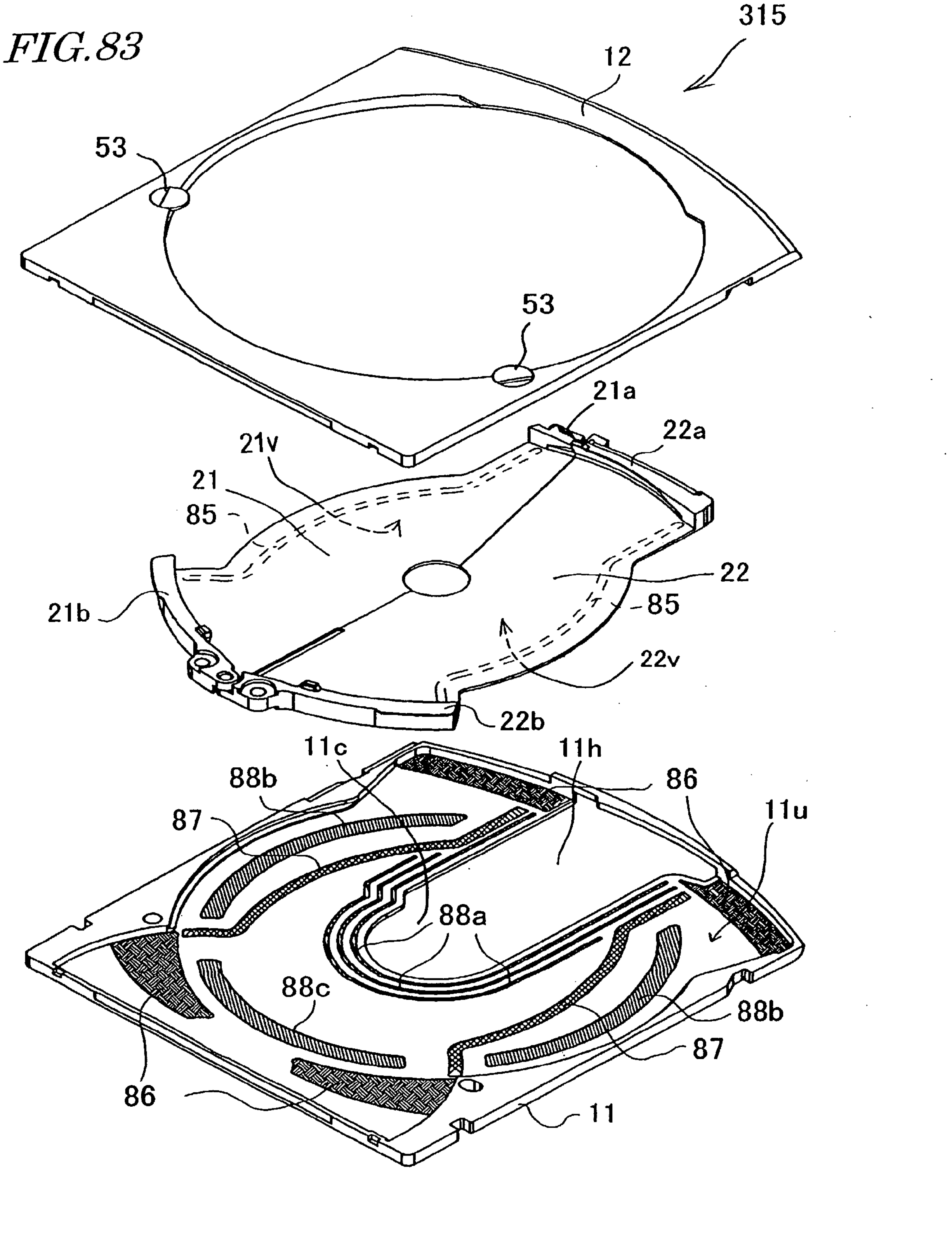

315
12
53
53
21a
22a
21v
21
85
22
21b
85
22v
22b
11c
11h
86
88b
11u
87
88a
88c
88b
87
86
11

FIG.84

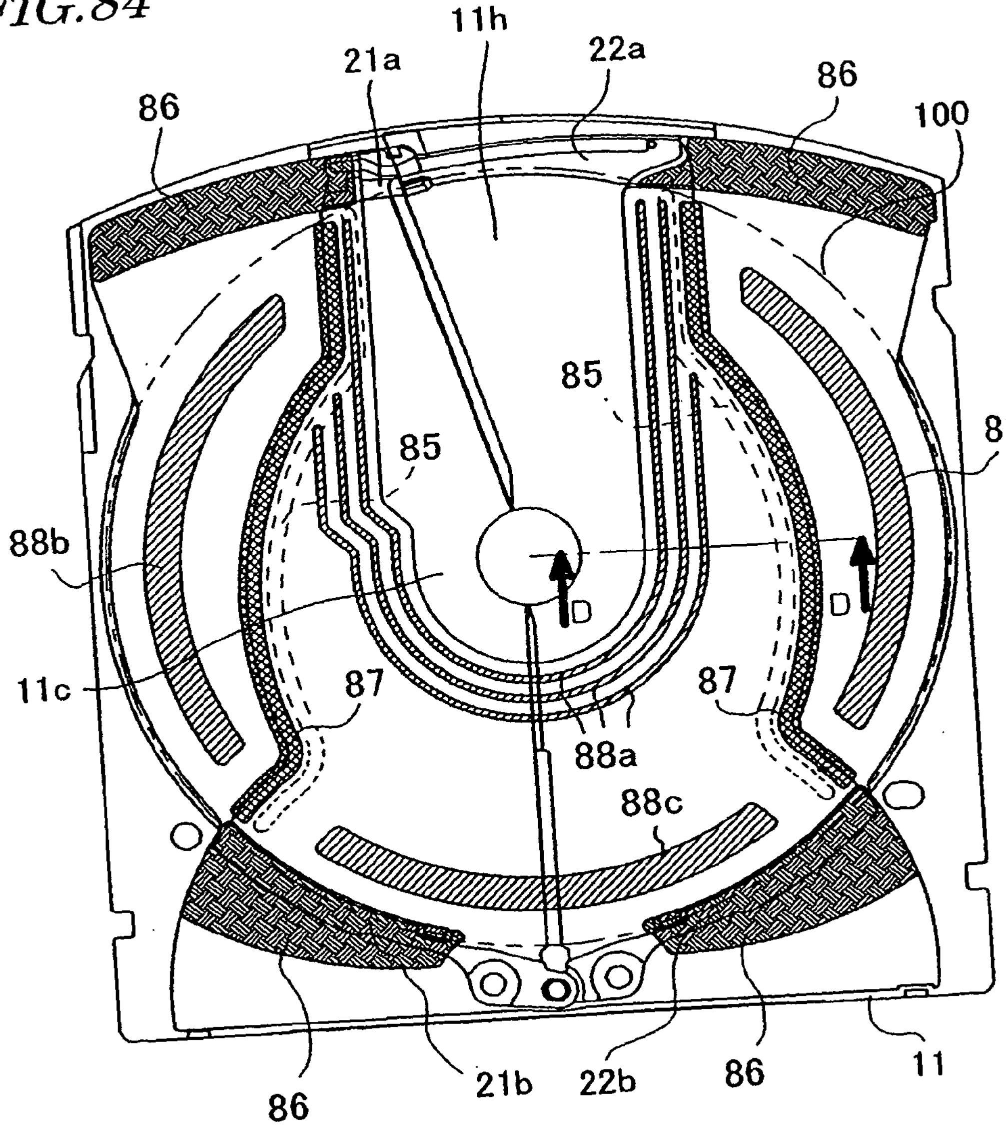

11h
21a
22a
86
86
100
85
85
88b
88b
D
D
11c
87
87
88a
88c
86
21b
22b
86
11
86

FIG.85

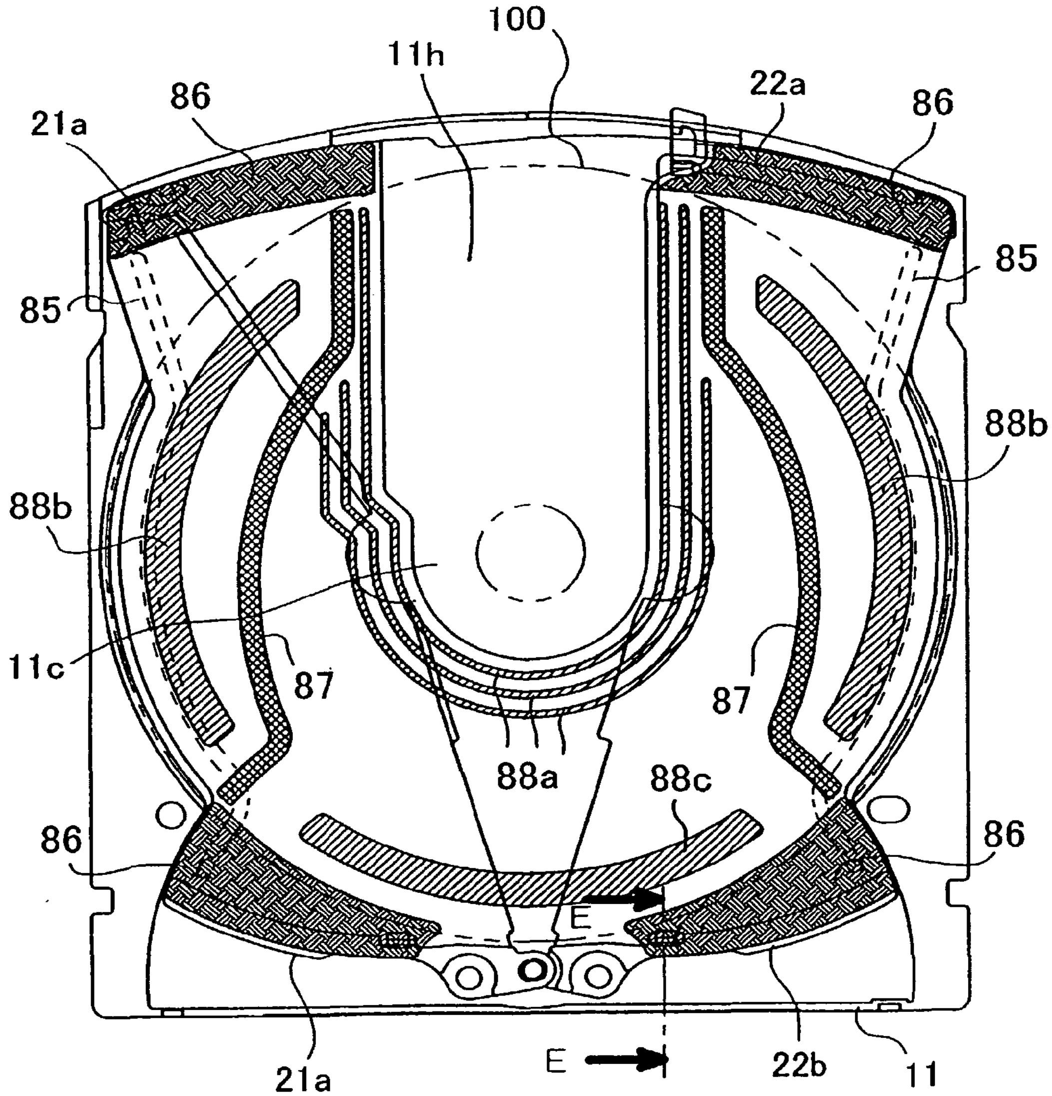

100
11h
22a
86
21a
86
85
85
88b
88b
11c
87
87
88a
88c
86
86
E
21a
E
22b
11

FIG.86

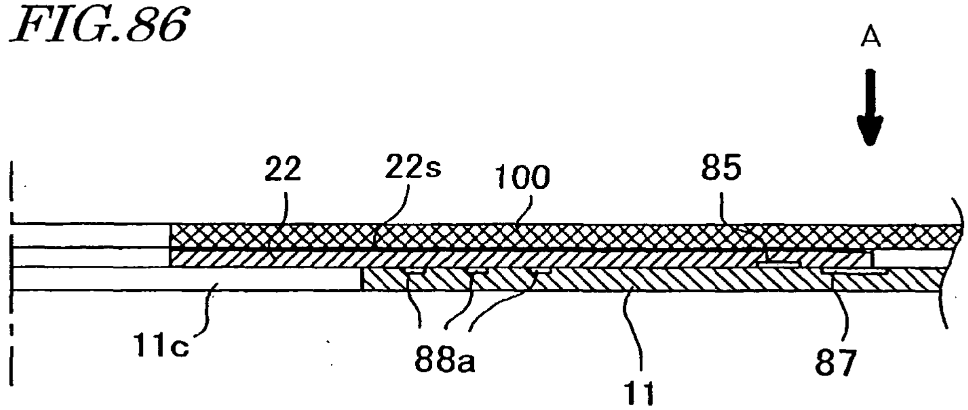


FIG.87

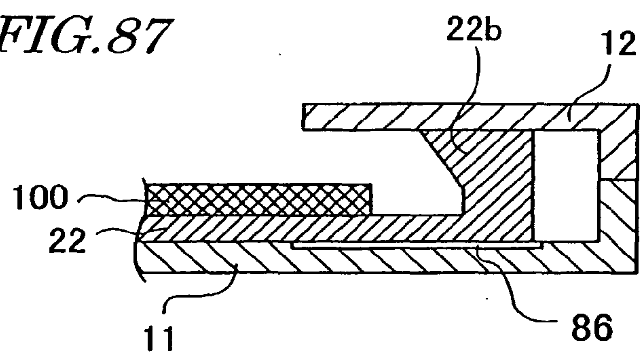


FIG.88

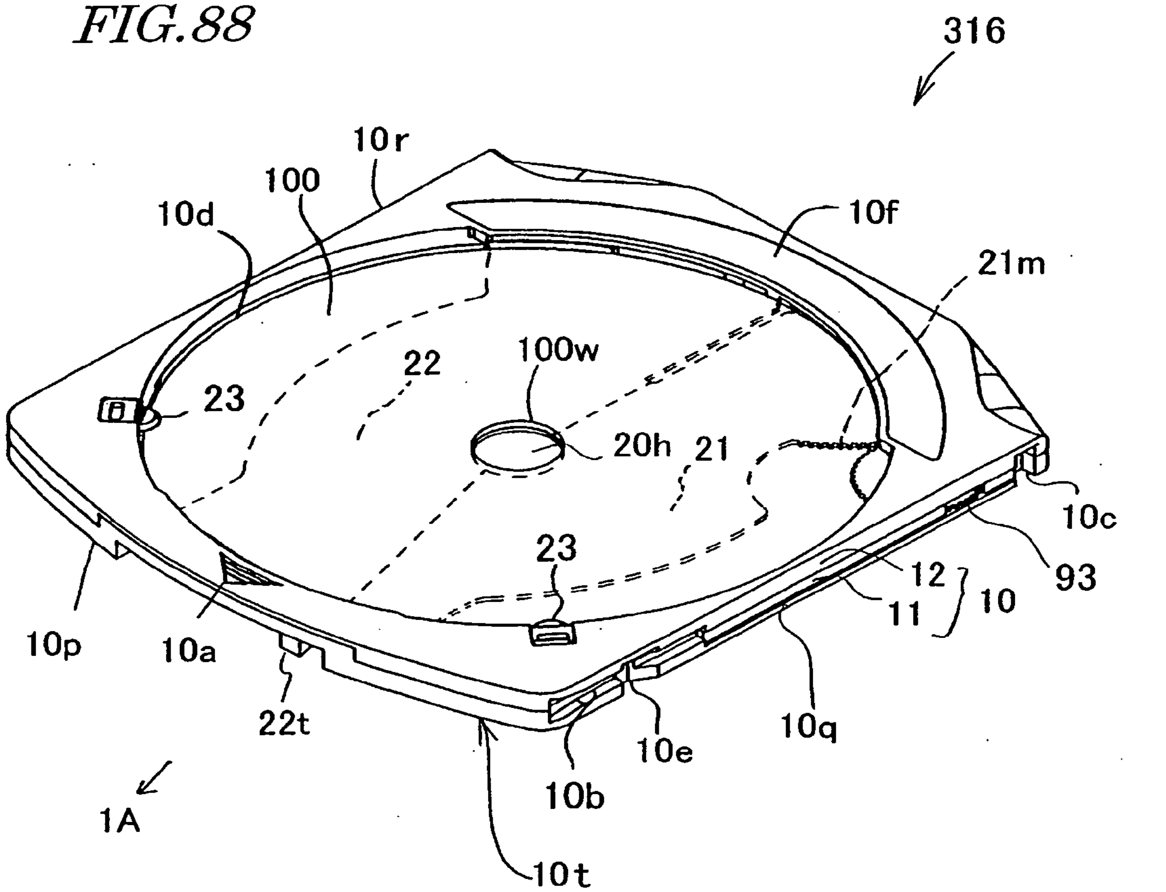
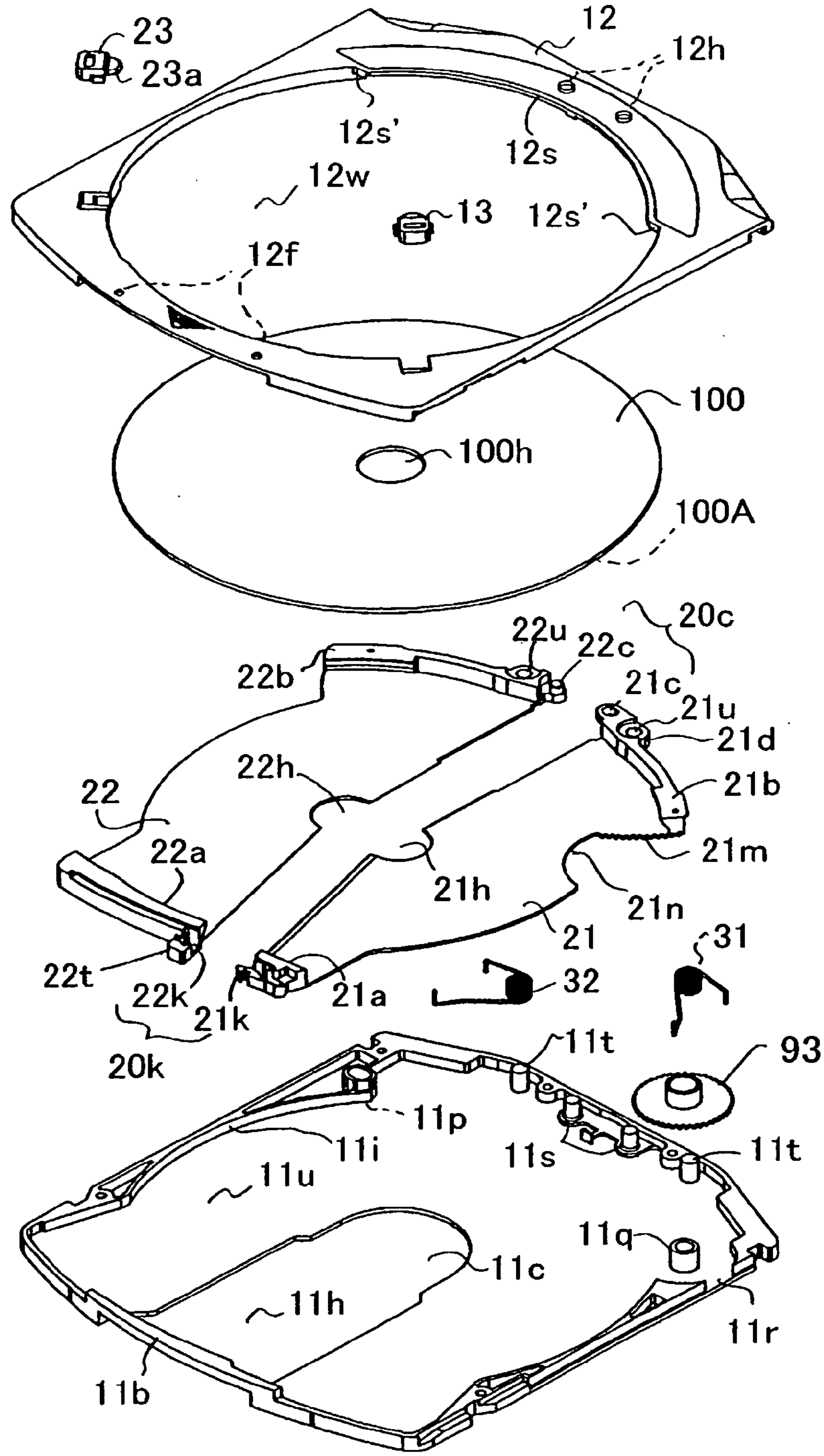

316
10r
100
10d
10f
21m
22
100w
23
20h
21
10c
23
12
93
11
10
10p
10a
22t
10q
10e
10b
1A
10t

FIG.89


23
23a
12
12h
12s'
12s
12w
13
12s'
12f
100
100h
100A
20c
22u
22c
22b
21c
21u
21d
22h
21b
22
22a
21m
21h
21n
21
31
22t
32
22k
21a
21k
20k
11t
93
11p
11i
11s
11t
11u
11q
11c
11h
11r
11b

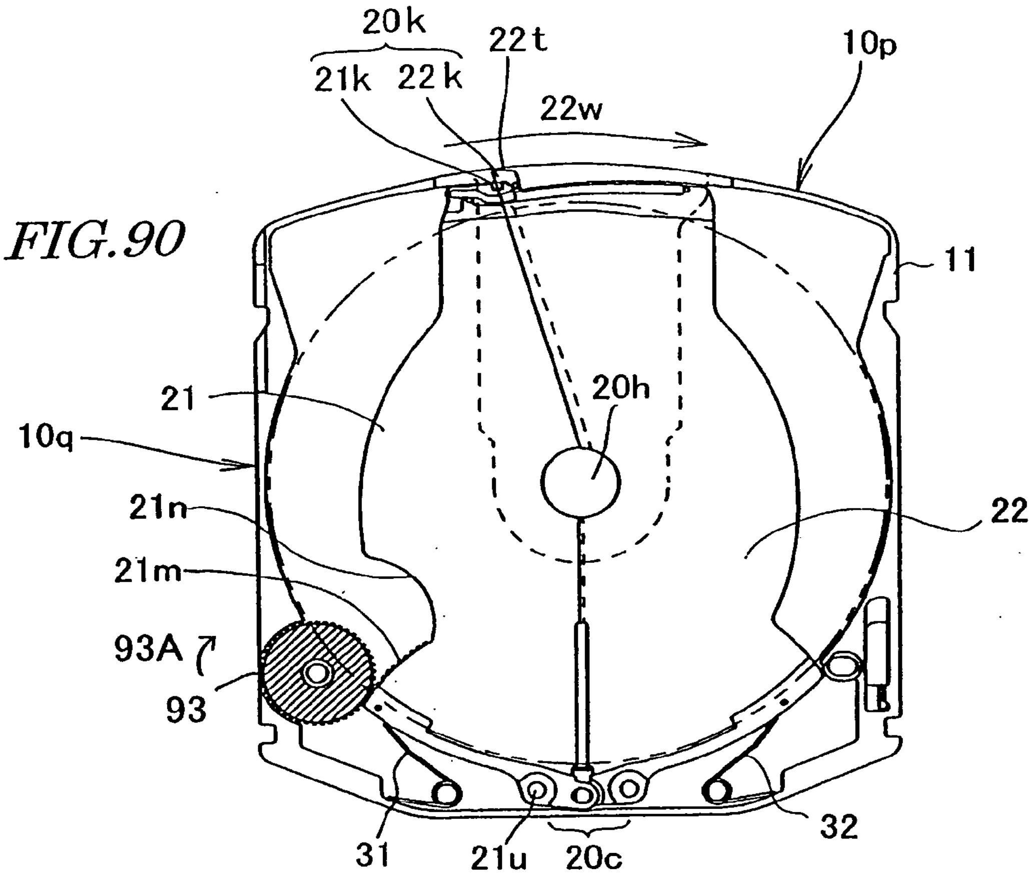

20k
22t
10p
21k
22k
22w
11
21
20h
10q
21n
22
21m
93A
93
32
31
21u
20c

FIG.90

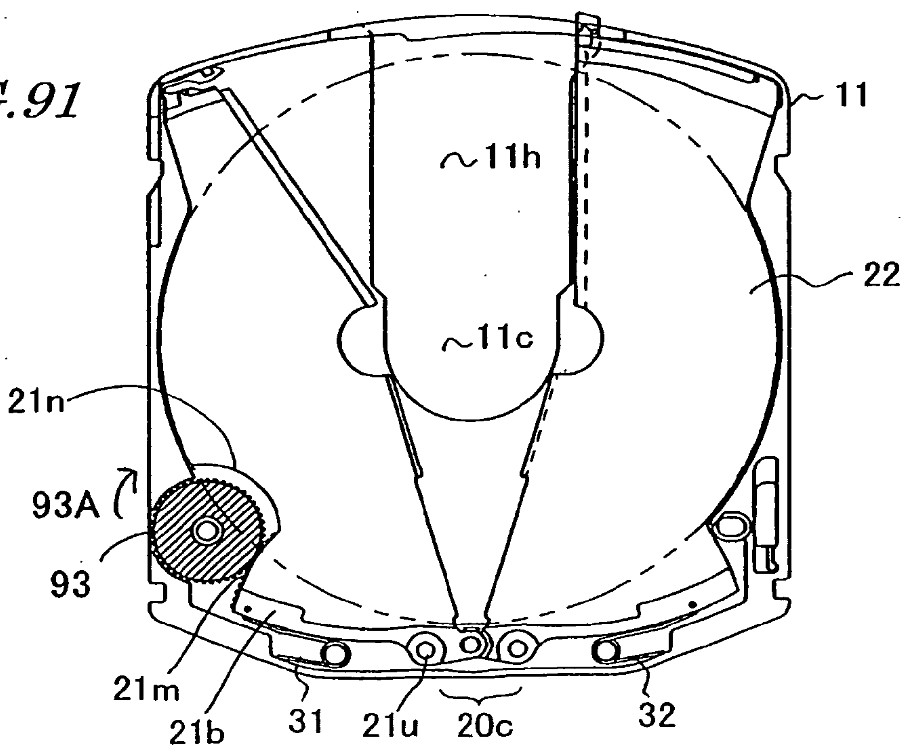

11
11h
22
11c
21n
93A
93
21m
21b
31
21u
20c
32

FIG.91

FIG.92

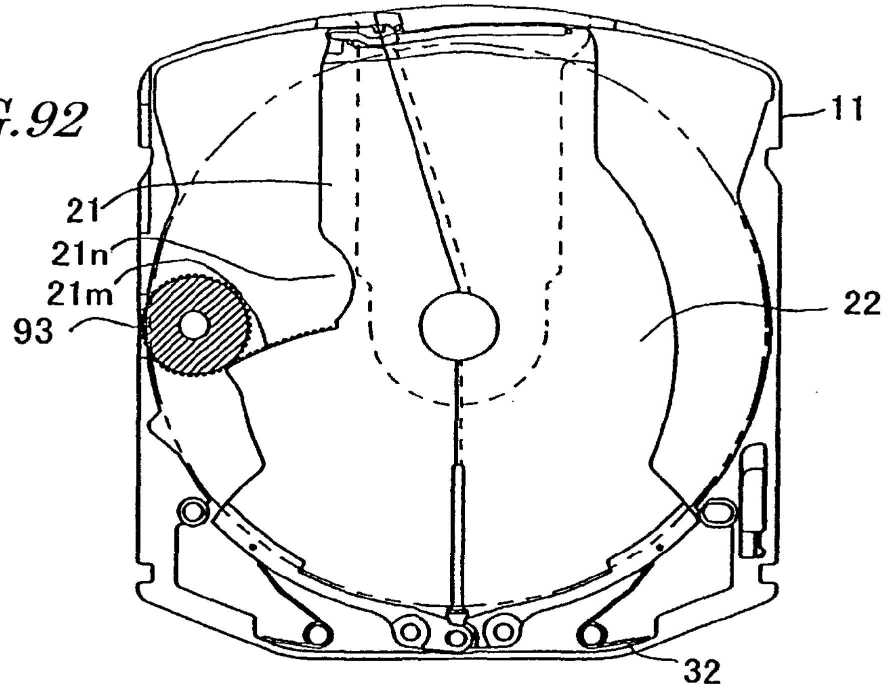


FIG.93

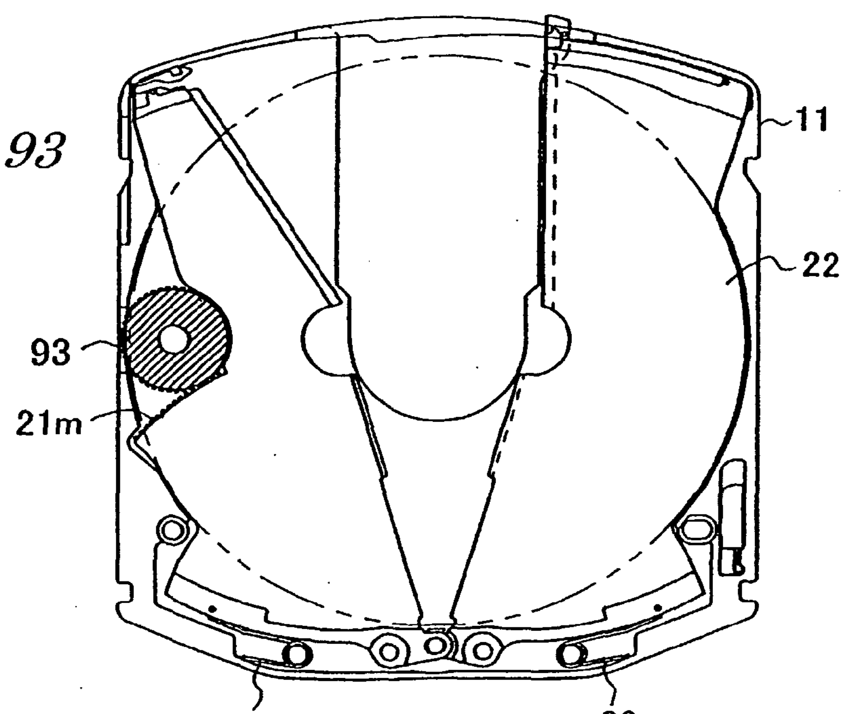


FIG.94

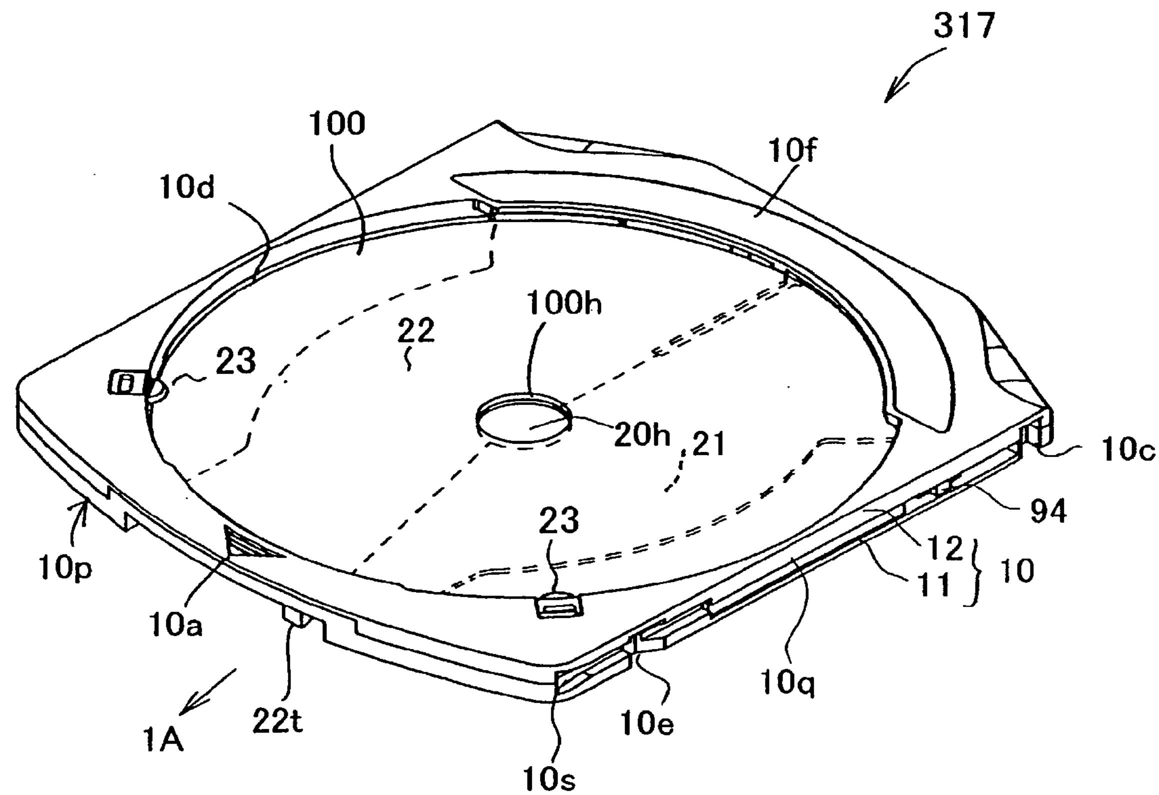

317
100
10f
10d
100h
22
23
20h
21
10c
94
23
12
10
11
10p
10a
10q
1A
22t
10e
10s

FIG.95

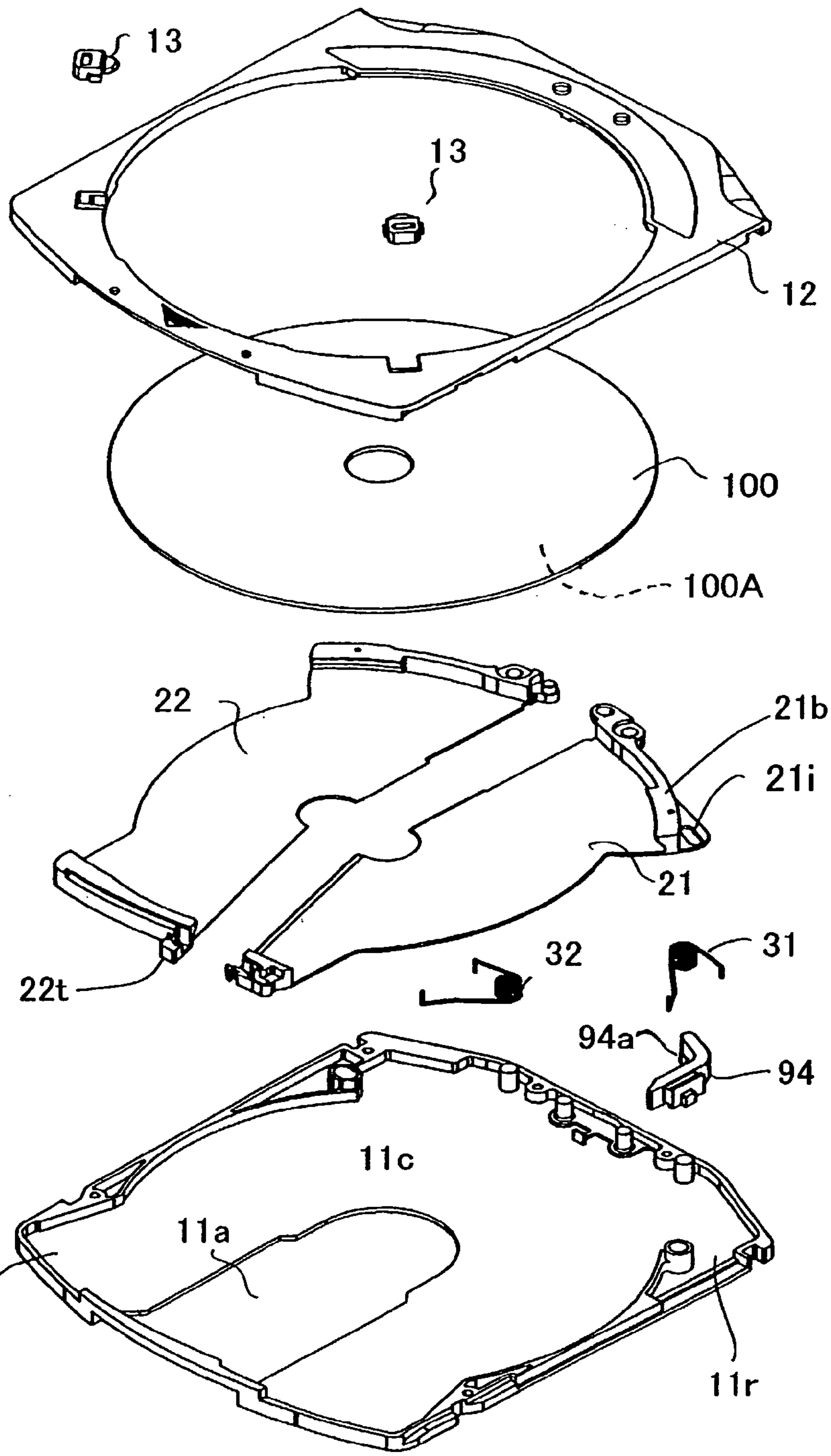


FIG.96

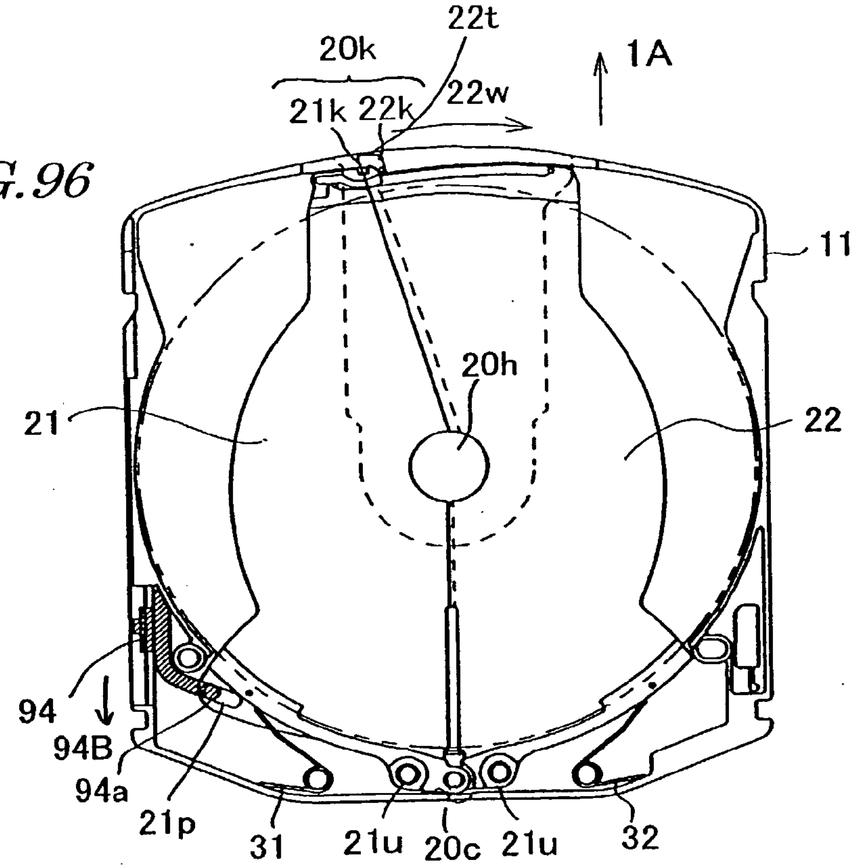

20k
22t
1A
21k 22k
22w
11
20h
21
22
94
94B
94a
21p
31
21u
20c
21u
32

FIG.97

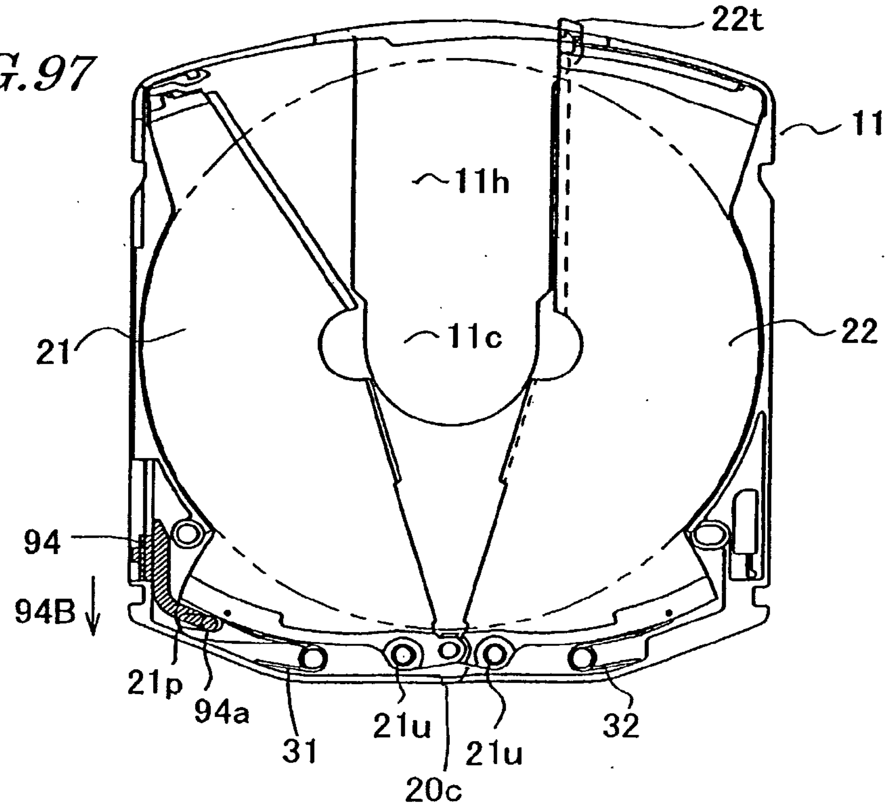

22t
11
11h
11c
21
22
94
94B
21p
94a
31
21u
21u
20c
32

FIG.98

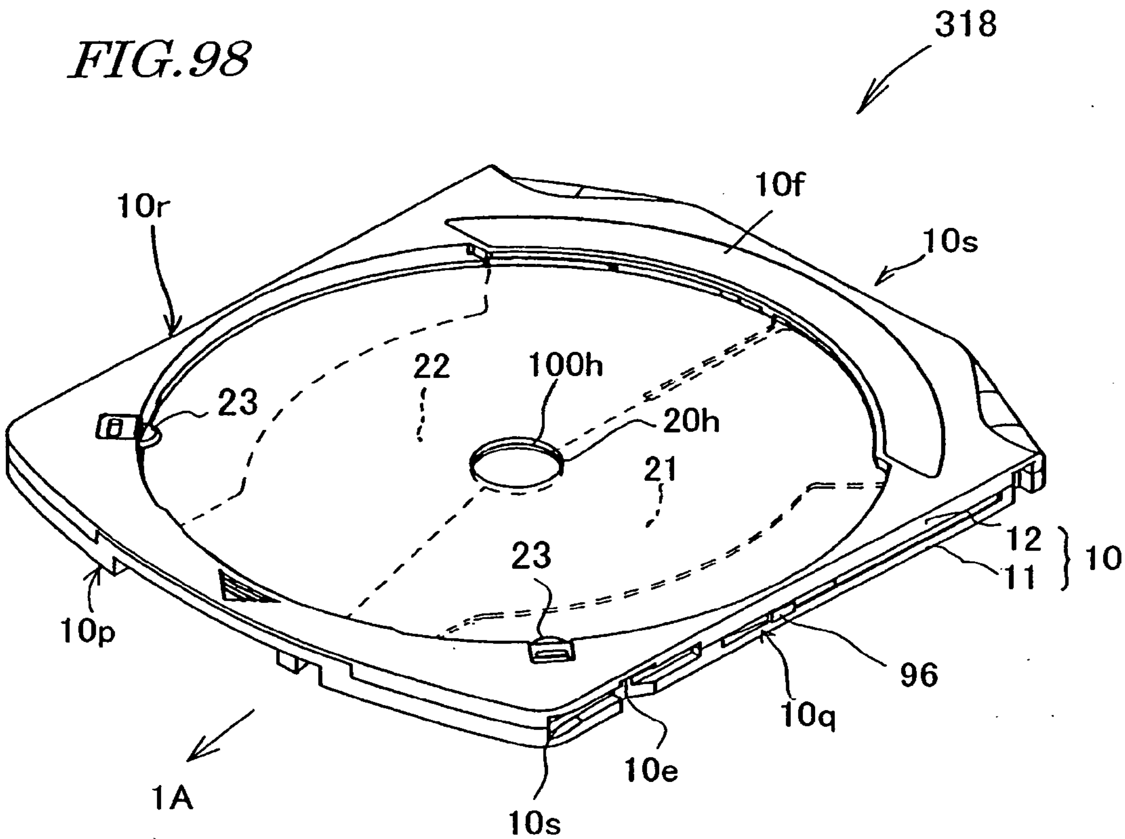


FIG.99

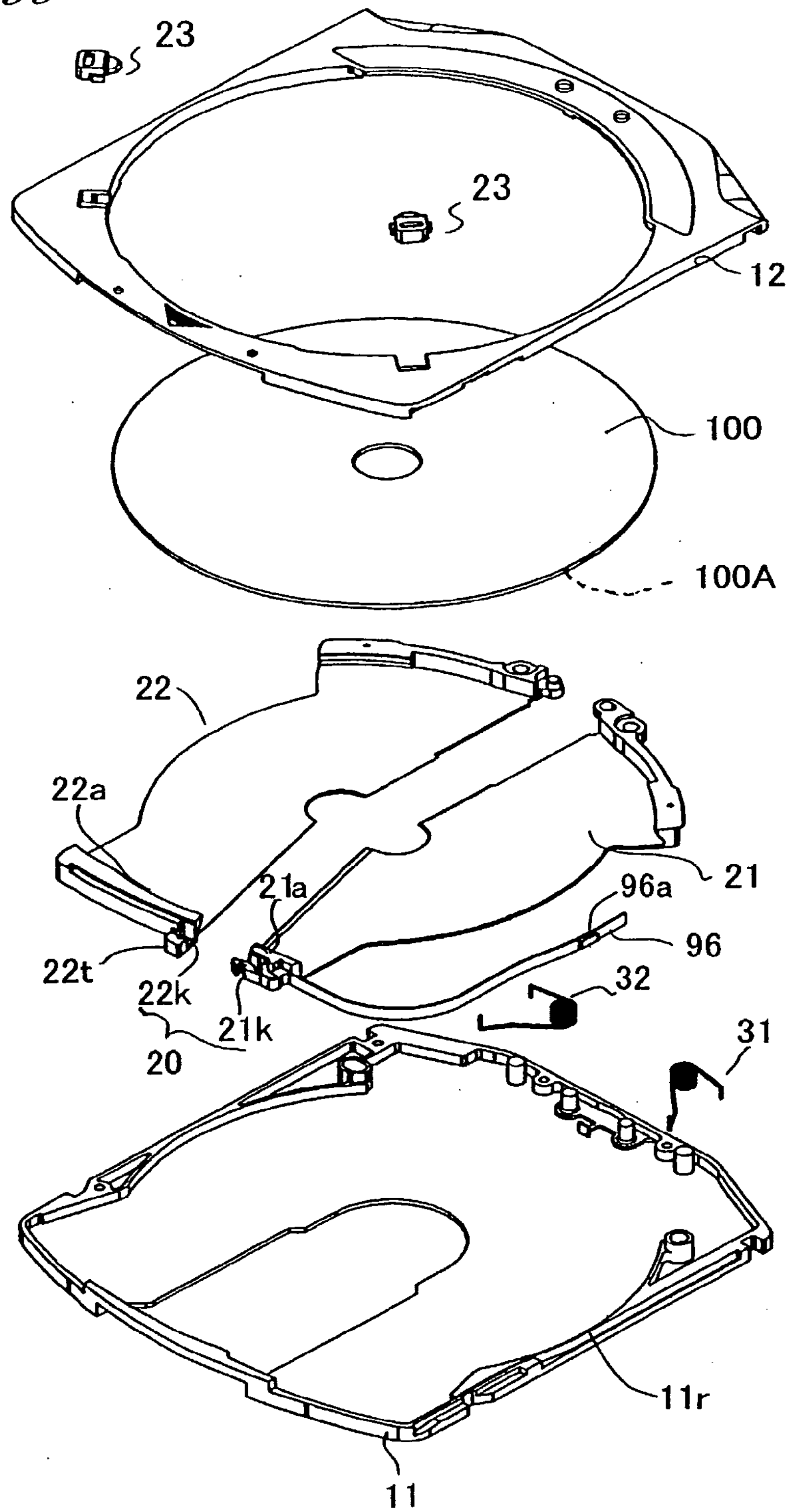


FIG.100

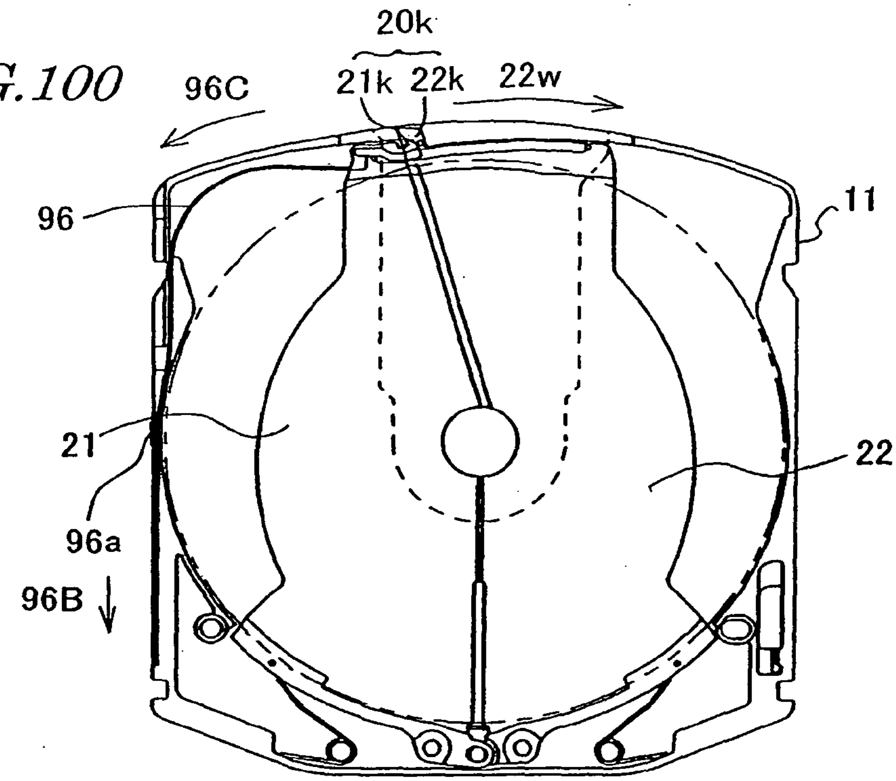


FIG.101

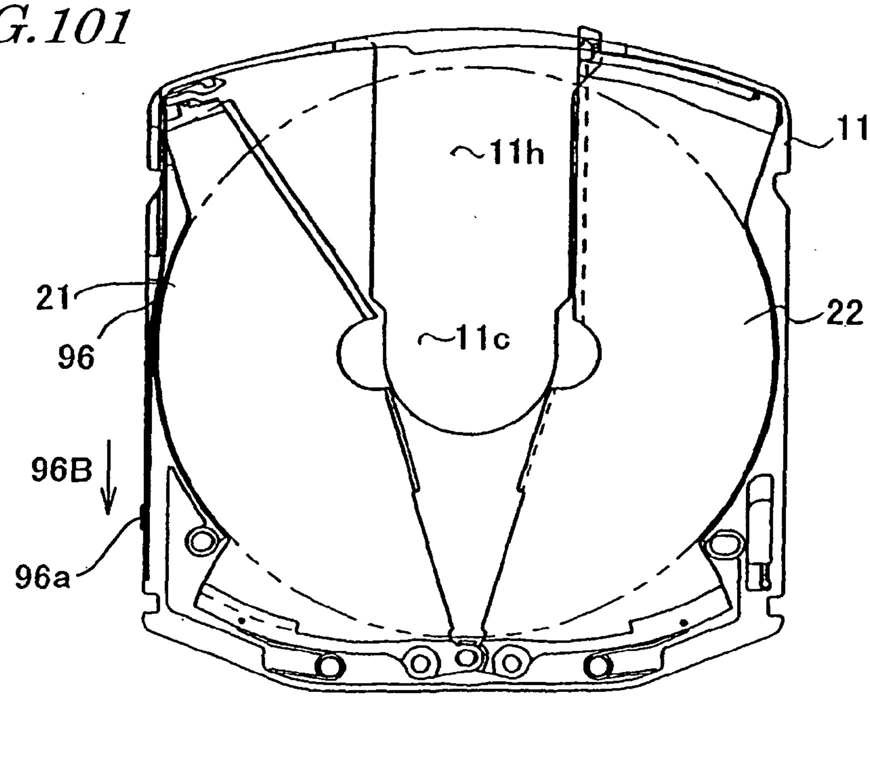


FIG.102

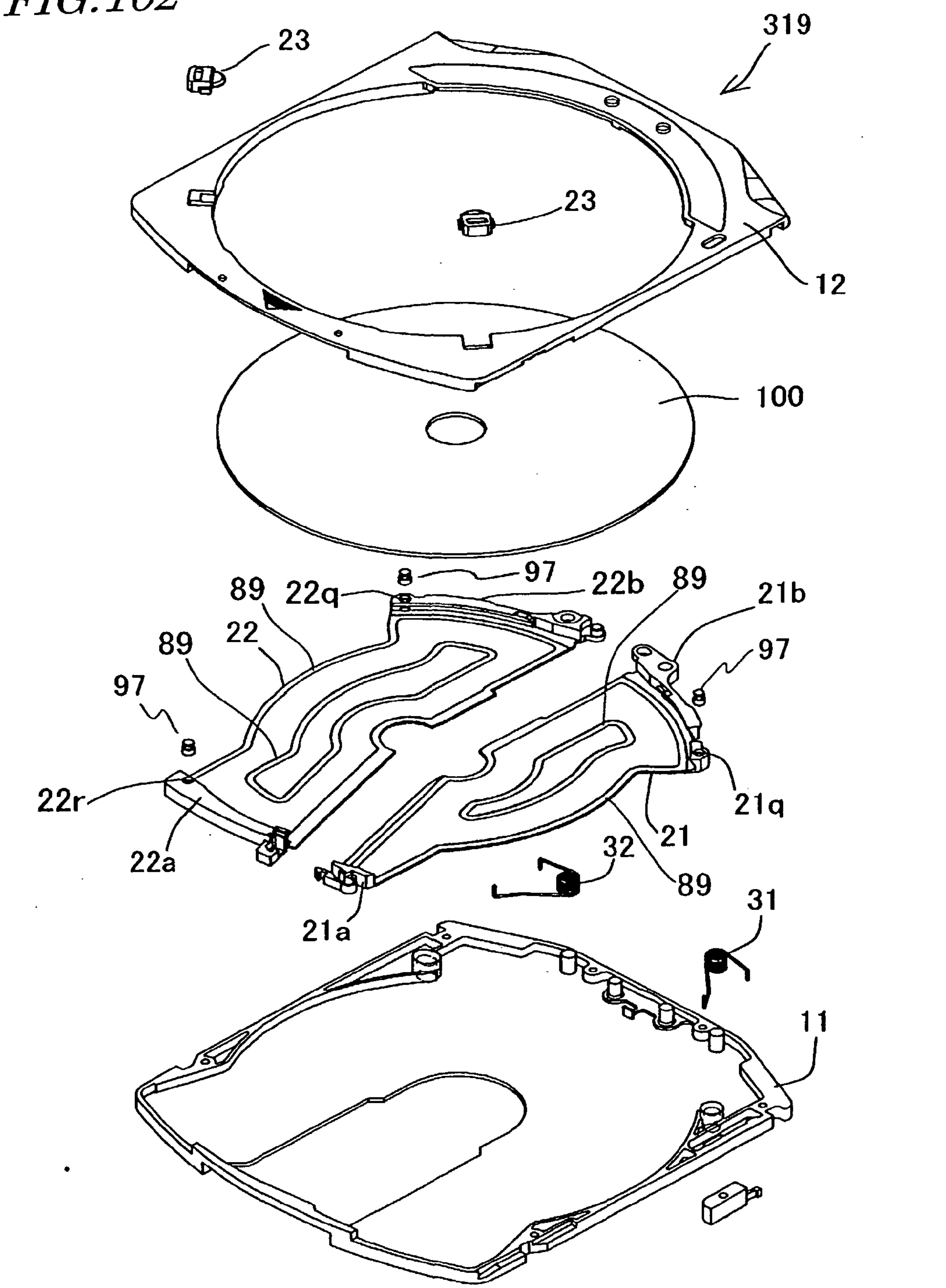

319
23
23
12
100
97
89
22q
22b
89
21b
22
89
97
97
22r
22a
21q
21
32
89
21a
31
11

FIG.103

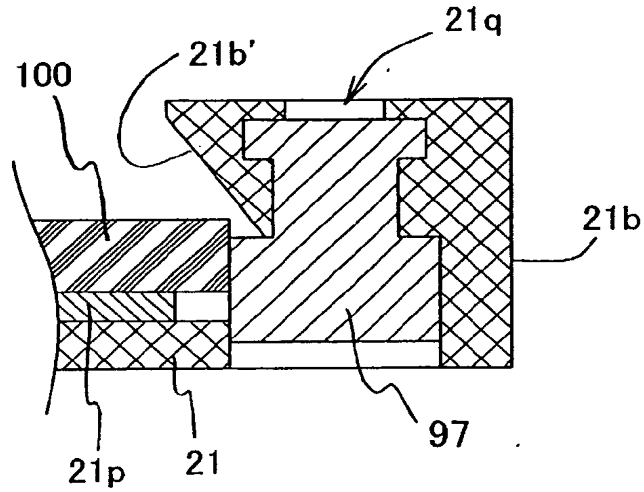


FIG.104

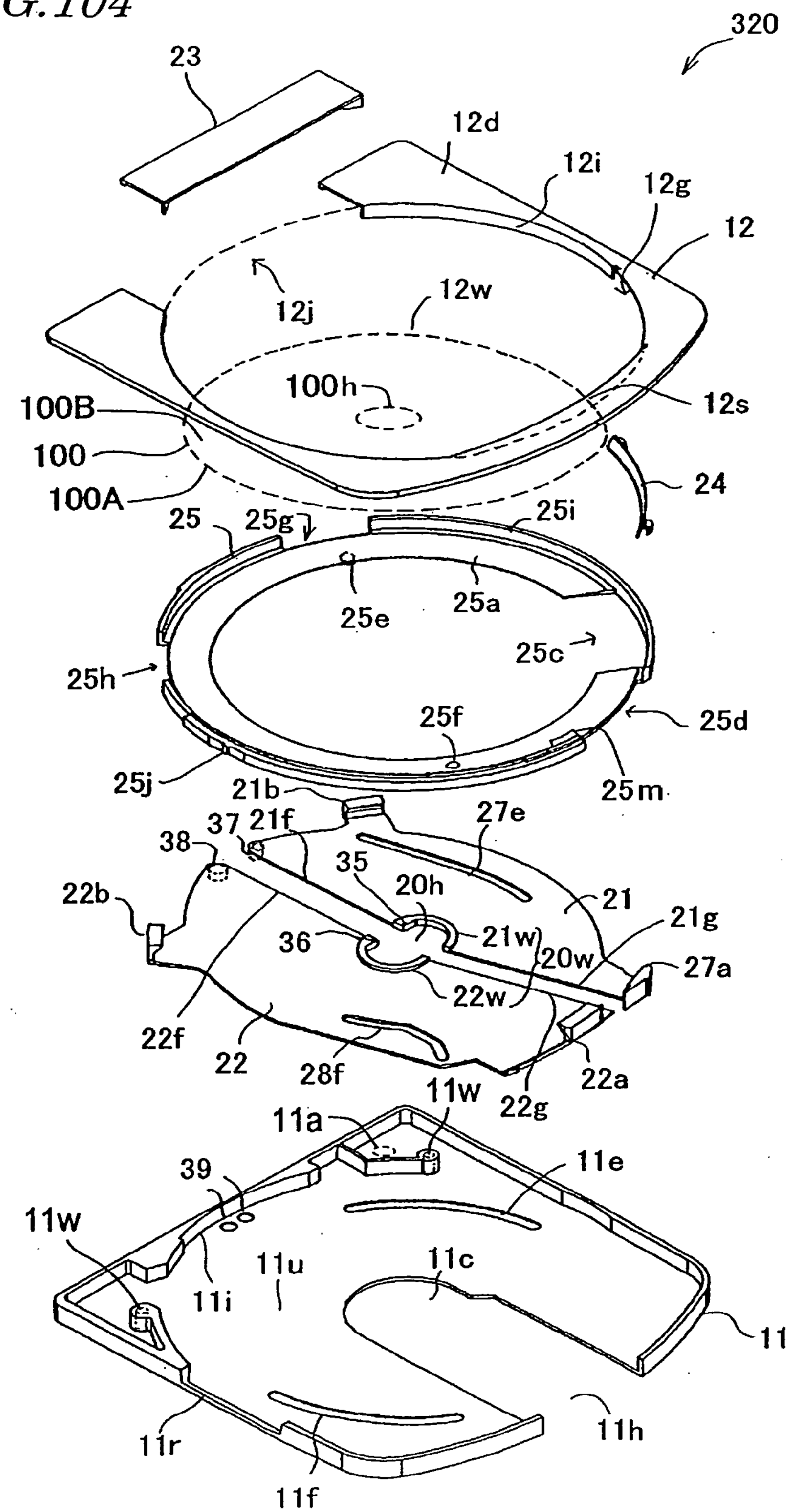

320
23
12d
12i
12g
12
12j
12w
100h
100B
12s
100
24
100A
25
25g
25i
25a
25e
25c
25h
25f
25d
25j
25m
21b
27e
37
21f
38
35
20h
21
22b
21g
36
21w
20w
27a
22w
22f
22
28f
22g
22a
11w
11a
11e
39
11w
11u
11c
11i
11
11r
11h
11f

FIG.105

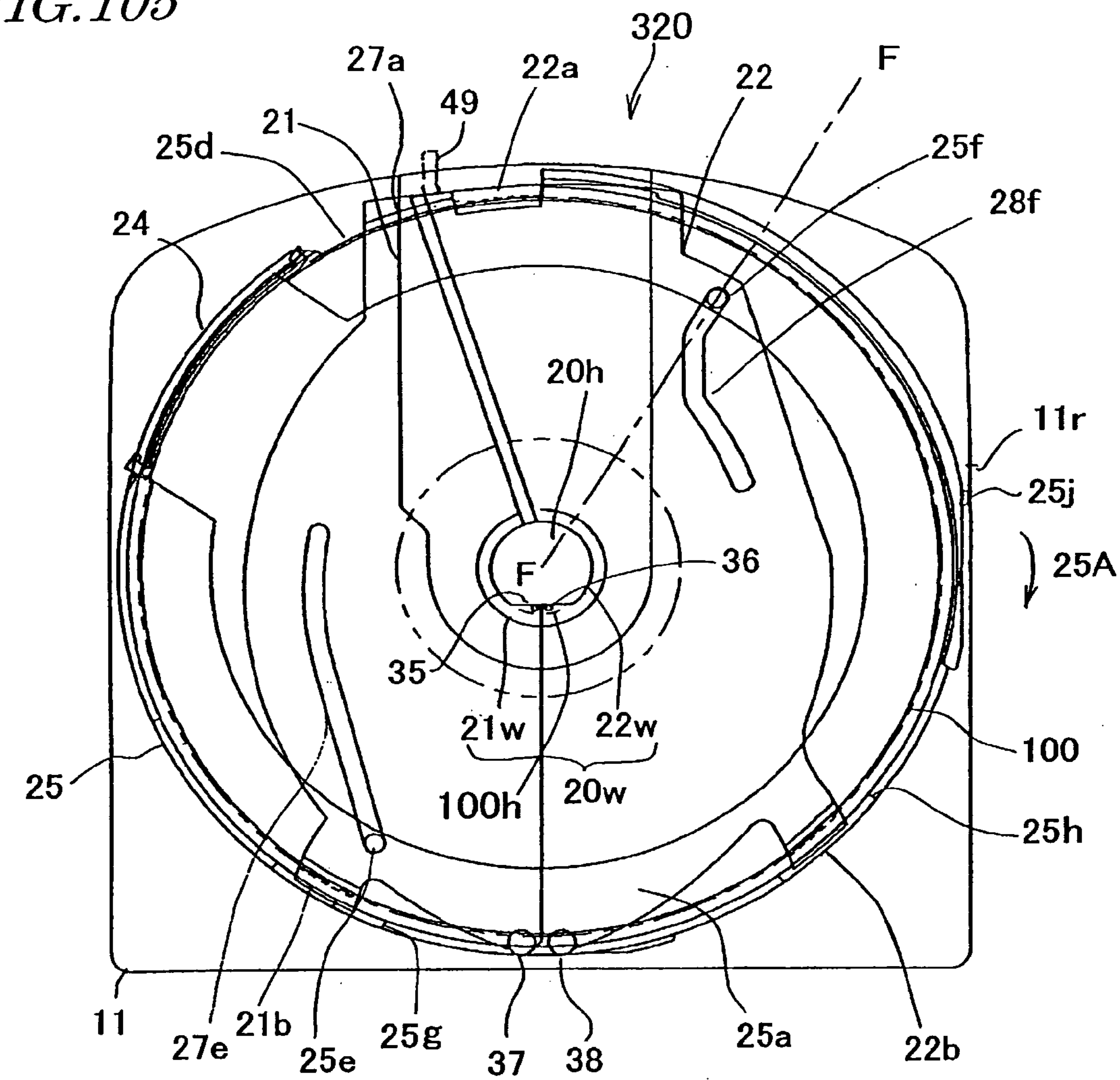


FIG.106

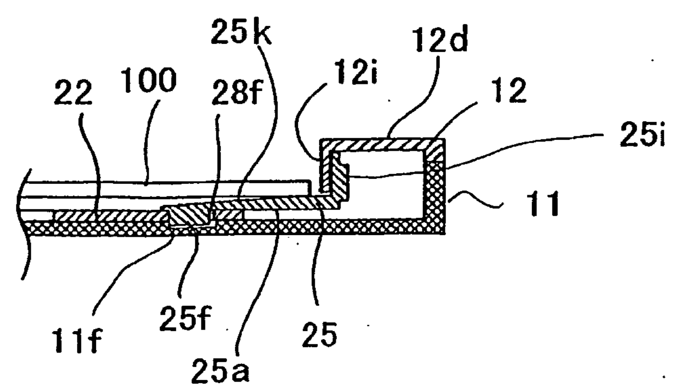


FIG.107

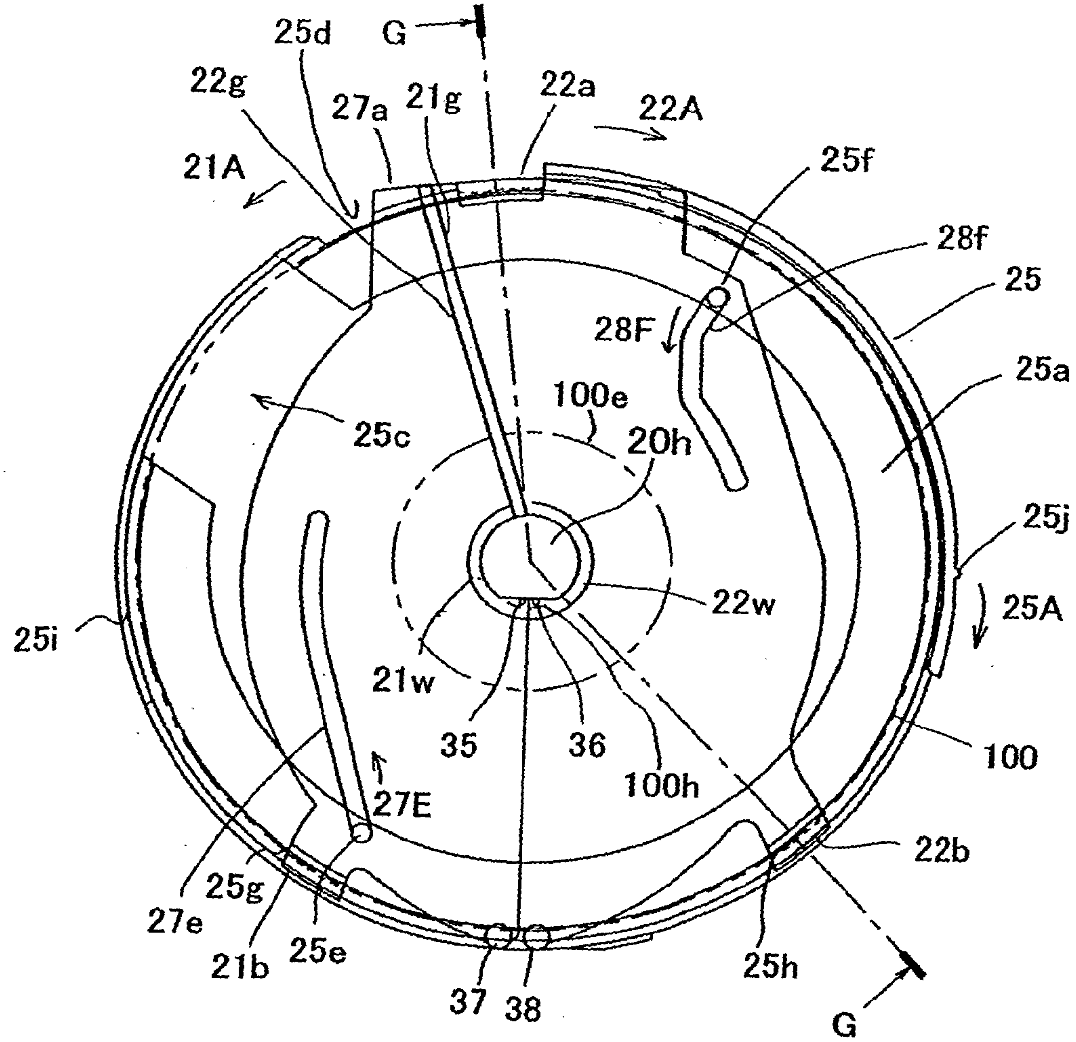


FIG.108

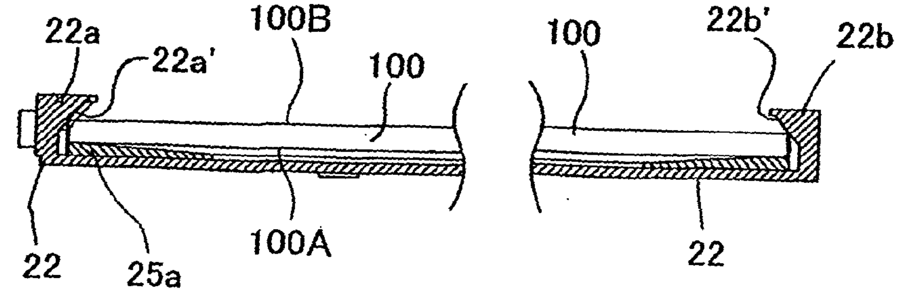


FIG. 109

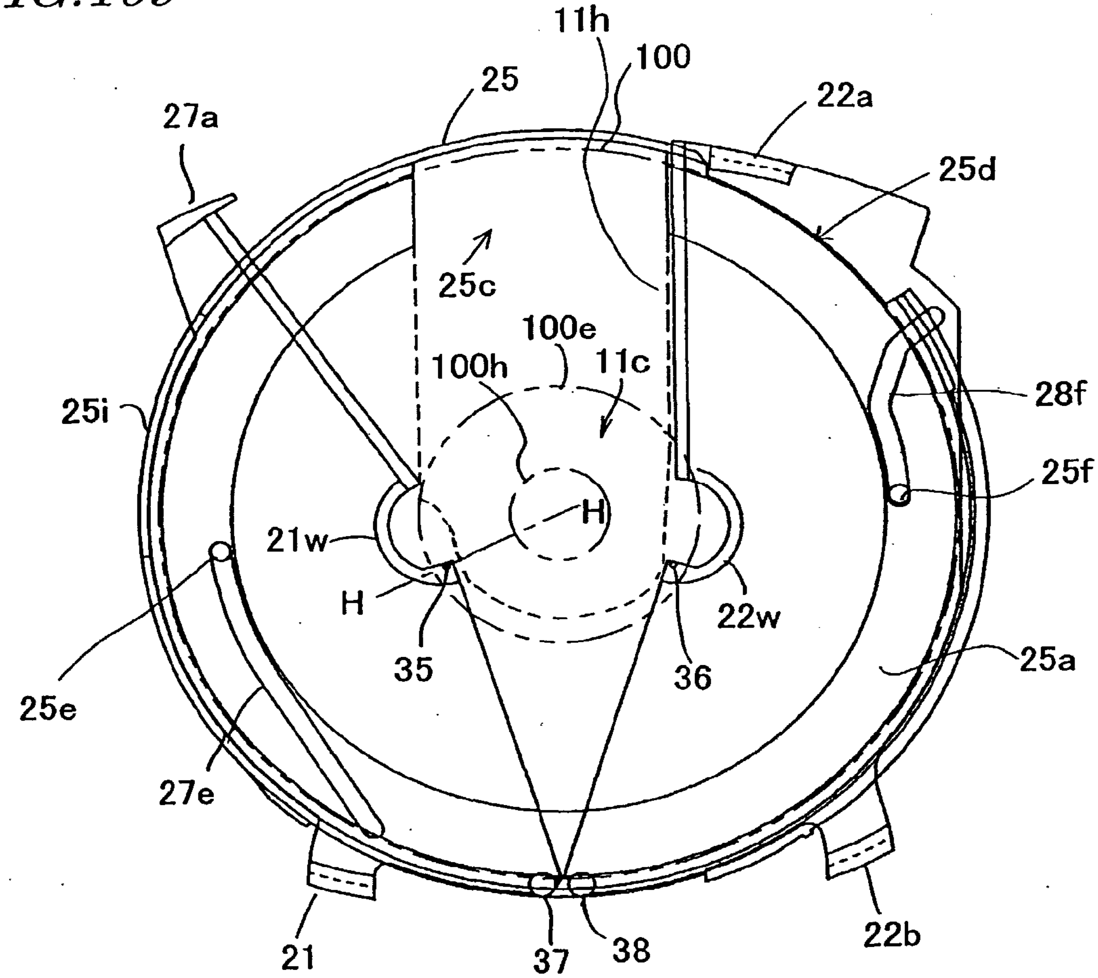


FIG. 110

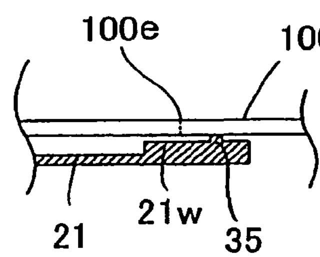


FIG.111

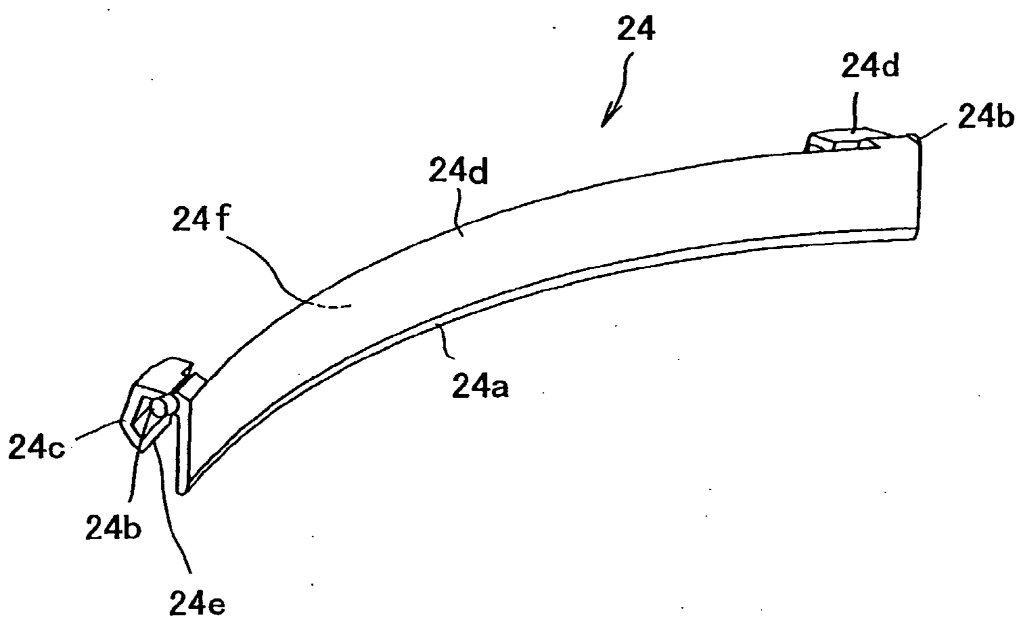


FIG. 112

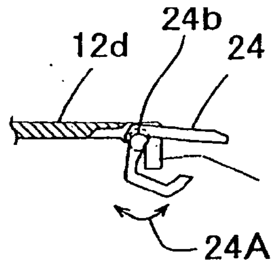


FIG. 113

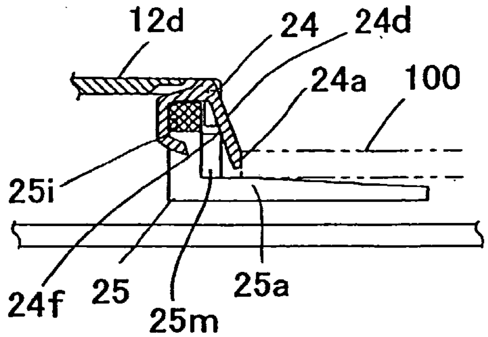


FIG. 114

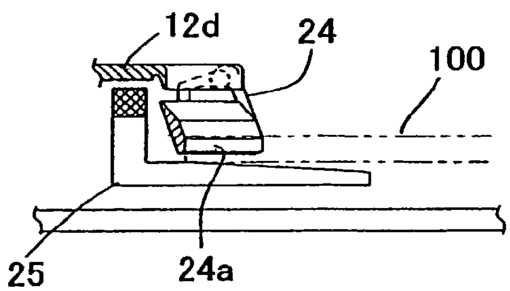


FIG. 115

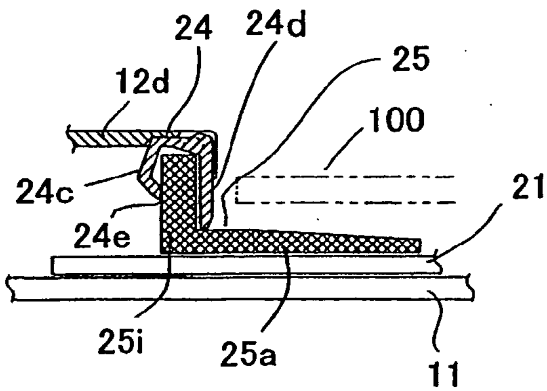


FIG. 116

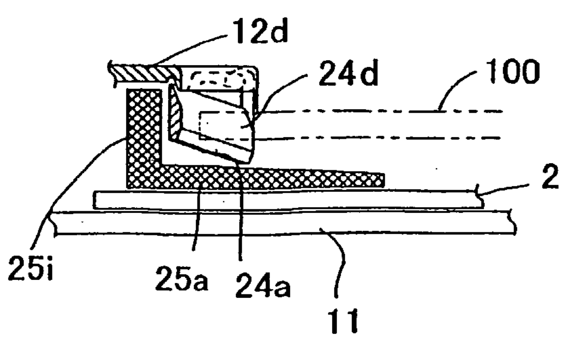


FIG.117

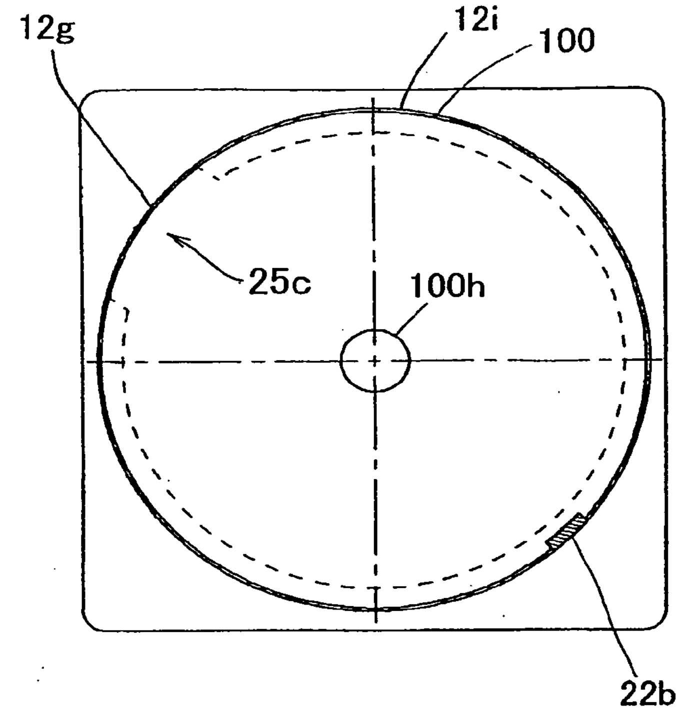


FIG.118

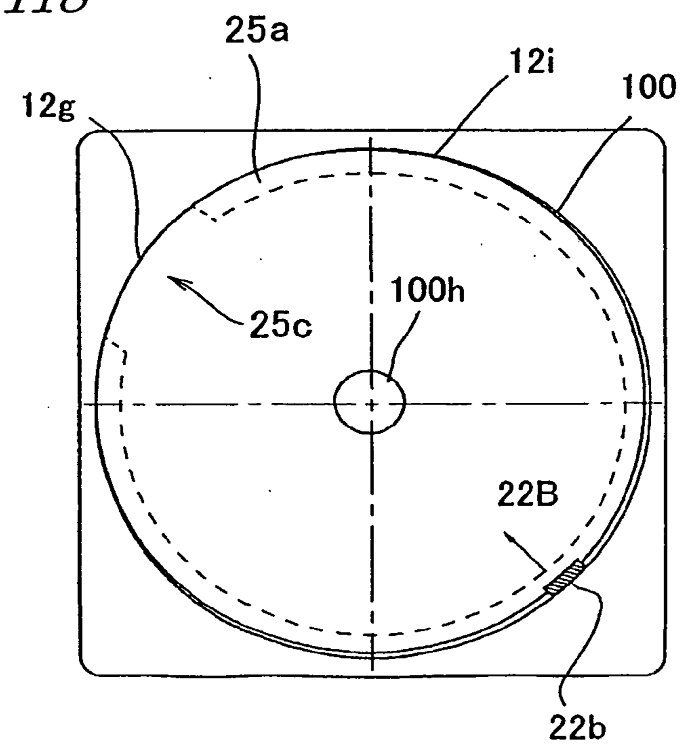


FIG.119

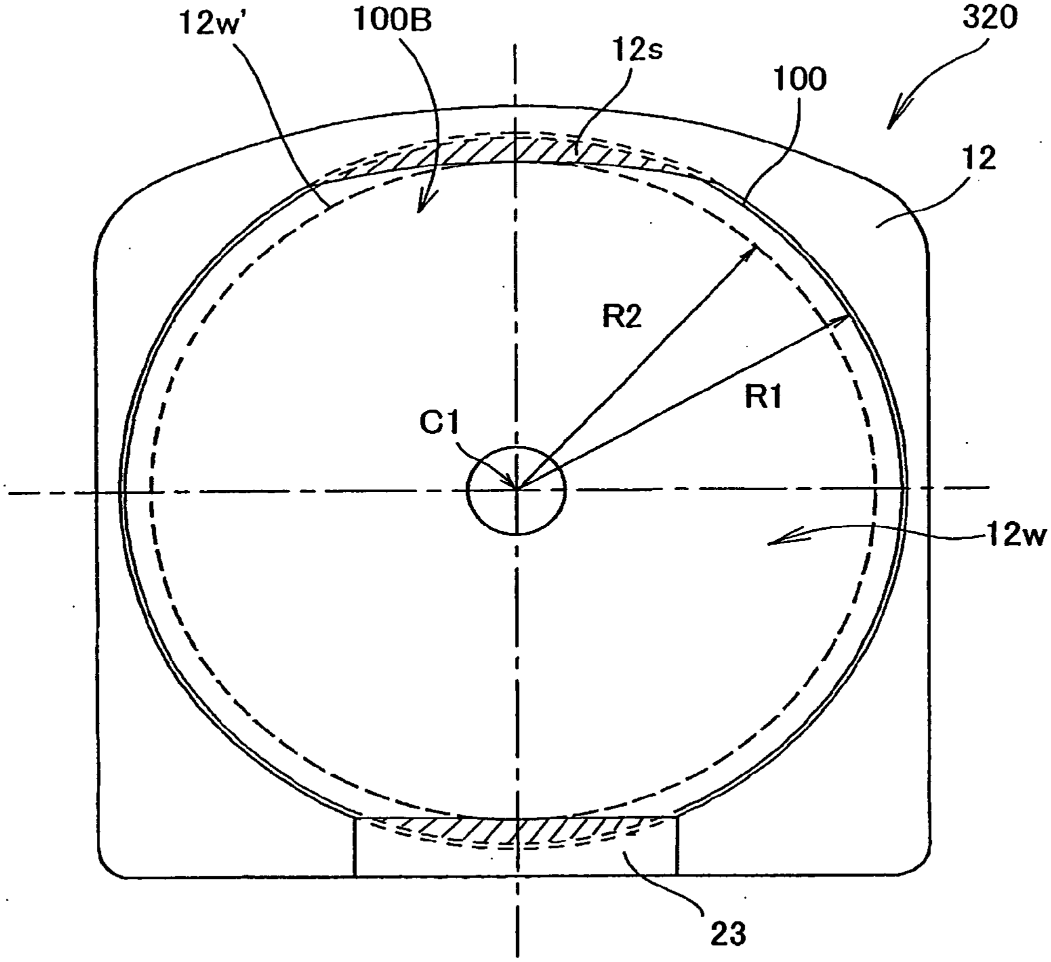


FIG. 120

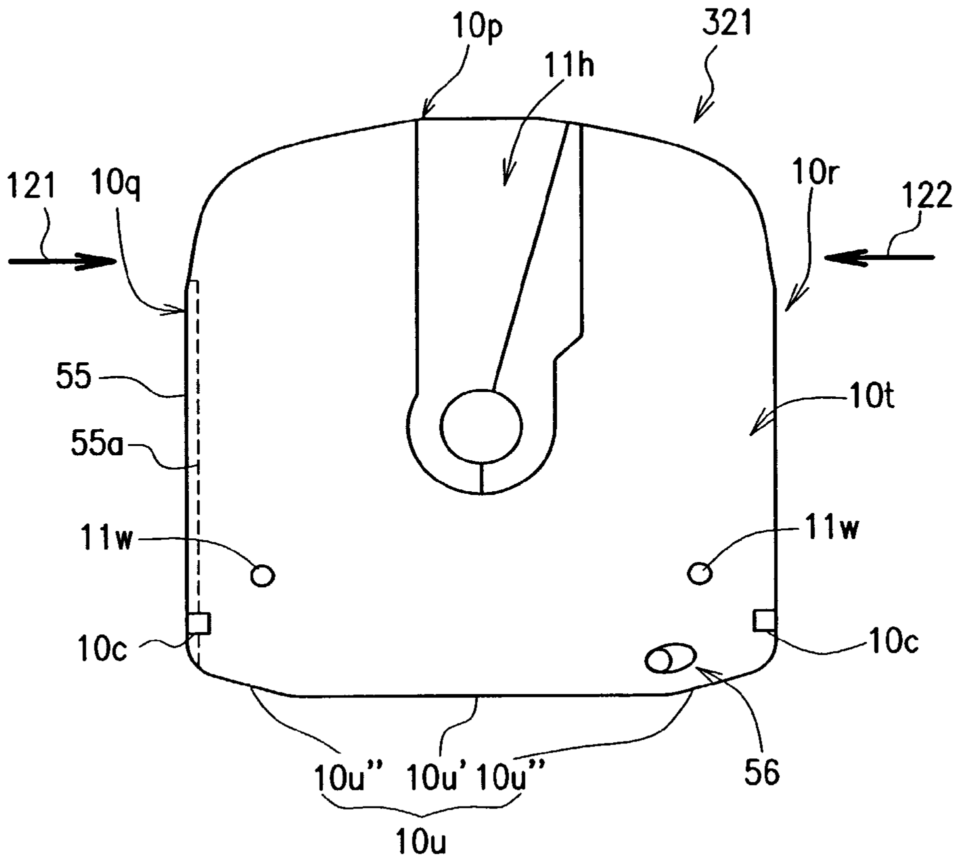

10p
321
11h
121
10q
10r
122
55
10t
55a
11w
11w
10c
10c
10u'' 10u' 10u''
56
10u

FIG. 121

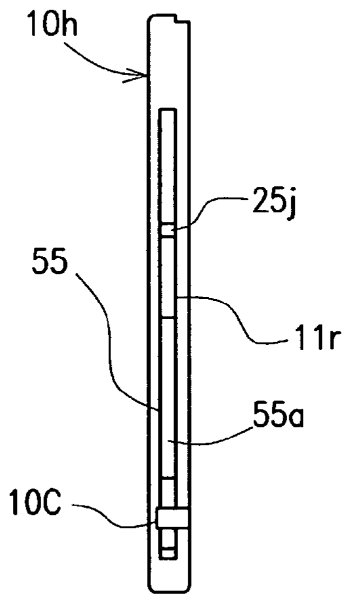


FIG. 122

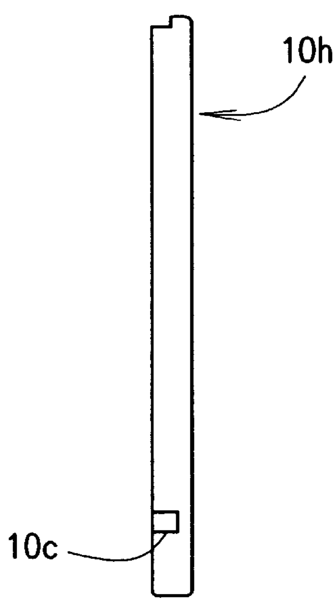


FIG.123

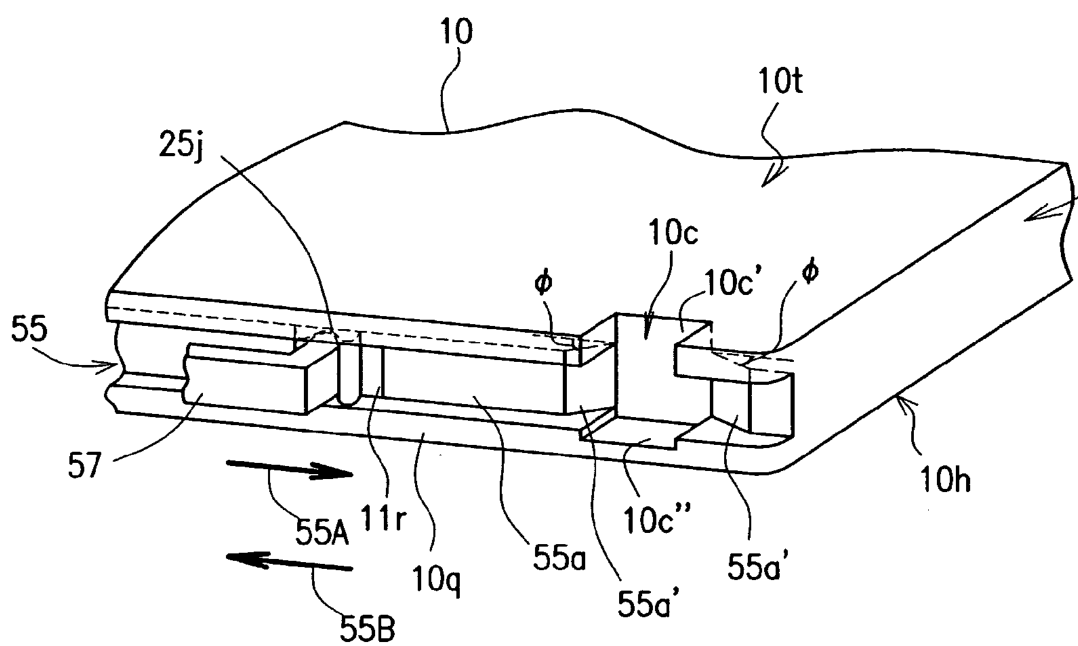


FIG.124

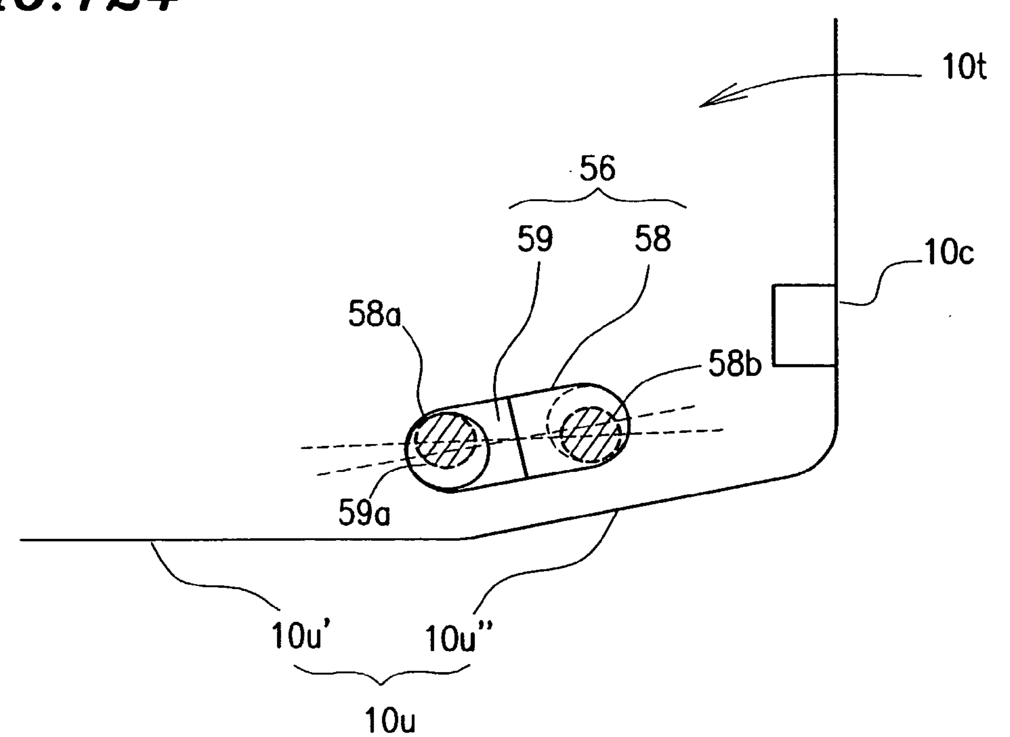


FIG.125

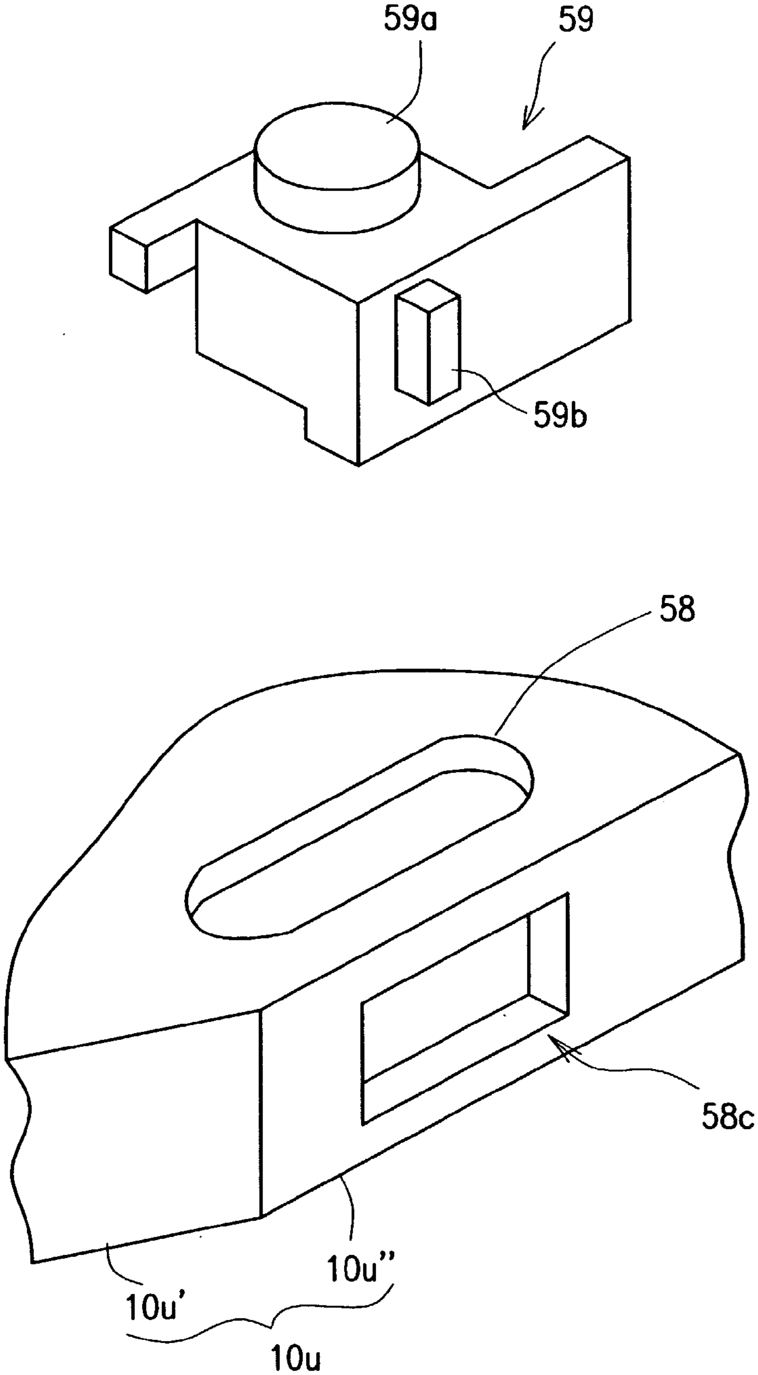


FIG. 126

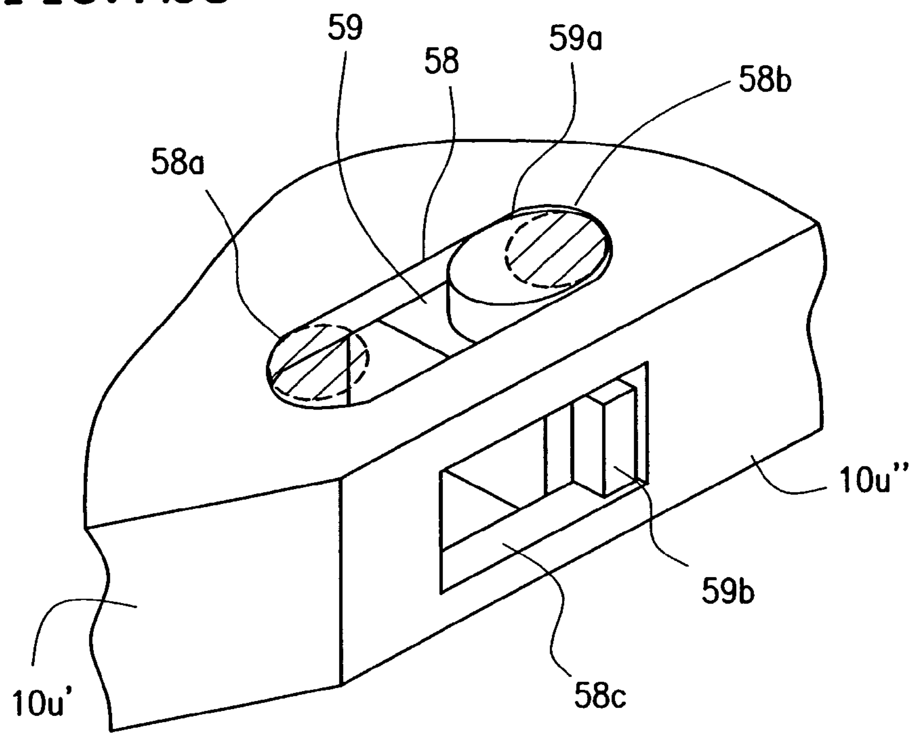


FIG. 127